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BUTTERFLY & OTHER INVERTEBRATES CLUB INC.

Management Committee

Aims of the organisation

- To promote the importance of invertebrates in the environment
- To hold information meetings and organise excursions around the theme of invertebrates
- To promote the conservation of the invertebrate habitat and encourage the growing of butterfly host plants
- To promote research into invertebrates
- To encourage the construction of invertebrate friendly habitats in urban areas

Contact details

PO Box 2113, RUNCORN, Qld. 4113. Email info@boic.org.au or secretaryboic@gmail.com.
Website: **boic.org.au** and BOIC on Facebook.

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Annual fees are $30 for families, individuals, schools, organisations.
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General meetings

Quarterly meetings, are held with guest speakers and to organise BOIC events.

Deadlines for publishing in *Metamorphosis Australia*

If you wish to submit an item for the publication the following deadlines apply:
1 February (March Issue), 1 August (September Issue).

All articles should be submitted directly to the Editorial Committee: secretaryboic@gmail.com.
This publication has been produced with the co-operation and combined efforts of the editorial committee, individual contributors, artists and photographers.

Disclaimer

This publication seeks to be as scientifically accurate as possible. The views opinions and observations expressed are those of the authors. It is a platform for people, both amateur and professional, to share information, news and images of butterflies and other invertebrates. The submitted manuscripts are reviewed with editorial changes suggested if applicable. The editorial committee reserves the right to refuse to publish matter that it deems unsuitable for publication.

Cover image: Photograph courtesy of Wesley Jenkinson,
Freshly emerged female Indigo Flash (*Rapala veruna simsoni*)

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Hello from the President

Issue 104 has arrived, and the management committee is particularly proud of all who have contributed to make this edition probably the most varied in subject titles, and a 60 page issue. Like Issue 103, we cover a broad range of invertebrate articles, butterflies, bees, cup moth larvae, plant hoppers, beetles (Carabidae) plus more. We have several book reviews, a field trip report, and several reports on guest speakers from the general meetings and the AGM. The member's subscription database which was adjusted to renew on the 1st January each year is working well, thanks to Bernie. Jon is currently our stand-in treasurer and his efforts have not gone unappreciated.

Again, the articles herein are of a particularly high standard, due in part to the good lead up time of six months between issues, the high standard of the authors who have submitted, and to the hard-working editorial team. I take this opportunity to thank them. A special note of thanks and congratulations to Wesley Jenkinson for his article on the life history of *Rapala varuna* (the Indigo Flash), with much new information to science provided by Wesley. I have not counted the number of life histories that Wesley has written but it must number greater than 60. Well done, Wesley.

Several of the members attended the last general meeting out at Karawatha in August and listened to the club's proposal aimed at re-establishing the Brown Soldier/Chocolate Argus butterfly (*Hedonia zelima*) in the Brisbane council area. This butterfly was last seen in Brisbane over 45 years ago and is now locally extinct. So, for further news on the development of the project, watch this space. Additionally, we spoke at the meeting about getting back to the core values of the club, in particular, the growing of butterfly host plants and provision of these free of charge to the community.

A big shout out to our Vice President, David, who has been very diligent and professional getting the Online Shop in order and sorting out the storage of the stock. On a final note, once again we thank our hard-working secretary for her hard work and dedication to make things happen in the club. Not to harp on the facts, but we are graced to have her supporting our club.

Yes, we are getting there

Sincere regards

Trevor

Life history notes, new host plants and new distribution records for the Indigo Flash, *Rapala varuna simsoni* (Miskin, 1874) (Lepidoptera: Lycaenidae)

Wesley Jenkinson

Distribution

The Indigo Flash, *Rapala varuna simsoni* (Miskin, 1874) (Fig. 1) is currently recorded from mainland New Guinea, through Torres Strait and sporadically along the east coast of Queensland to southern Queensland (Braby 2000). The mapped range in Braby (2016) shows Brisbane as the southern limit of the species, although Sankowsky (2020) extended it a little further south to the New South Wales border. However, in October 2006, G. Newland (pers. comm.), collected larvae approximately 12 km east of Murwillumbah, later confirming adults. John Moss (pers. comm.) has a male specimen collected a little further south at Cudgera Creek near Pottsville, in April 2000. Additionally, in July 2019, at Bogangar, I observed numerous adults flying around large Tuckeroo trees (*Cupaniopsis anacardioides*: Sapindaceae), a known host plant. These three previously unpublished records extend the distribution of the species into north-eastern New South Wales.

Fig. 1. Resting adult male

The butterfly occurs in a wide variety of habitats ranging from rainforest to open eucalypt forest and savannah woodland (Braby 2000). It also breeds in suburban gardens where suitable host plants exist. I have found that the butterflies have been more regularly observed in my garden since the host plants have matured in size.

Description

In appearance, the overall upperside wing colour of the freshly emerged male is a dark indigo and the female a dull slaty blue (Figs 2, 3), while the underside ground colour is dull brown with a lilac suffusion in the male (Figs 1, 4) and dull grey-brown with a slight lilac suffusion in the female (Fig. 5). Compared with the female, the wing termen of the male is straighter. In addition, males have a whitish patch of sex scales above the cell of the upperside of the hindwing (Fig. 2) and a corresponding patch of erectile hair-like scales on the dorsum of the underside

of the forewing (Fig. 4). Additionally, Corbet and Pendlebury (1992) and Parsons (1998) reported the presence of a "trident sex brand", which appears as a thickening of the base of veins CuA1, CuA2 and M3 on the upperside of the male forewing (Fig. 2). The appearance of the adults is very uniform, with little variation recorded. There also appears to be no record of summer and winter forms.

The adults of several other species could be confused with *R. varuna*. For example, females of the Bright Cornelian (*Deudorix diovis*), and the Dull Cornelian (*D. epijarbas*) from northern Queensland could be mistaken for this species. However, with careful observation the differences can be discerned. When comparing them, the underside of female *R. varuna* is dull greyish-brown and has a conspicuous single straight, or slightly curved, dark brown band transversely across the centre of both wings, notably more visible across the hindwings when at rest (Figs 5, 23). The underside of female *D. diovis* is much paler, with the forewing having two, irregular, white-edged, slightly darker grey bands, and in addition the upperside is dark grey-brown rather than the pale blue colour of *R. varuna*. The underside of female *D. epijarbas* is also paler than *R. varuna*. Wingspans for the adults pictured are 29 mm for males and females (Figs 2–5).

Fig. 2. Male upper

Fig. 3. Female upper

Fig. 4. Male under

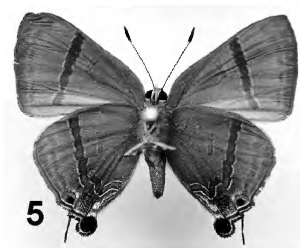

Fig. 5. Female under

Larval hosts

At the time of Braby (2000), seven host plants from five families (Elaeagnaceae, Fabaceae, Mimosaceae, Rhamnaceae and Sapindaceae) were recorded as hostplants of *R. varuna*. Since then, several new hosts have been discovered including several in three additional families, bringing the total to 18, in eight families. One of these is Native Mulberry (*Pipturus argenteus*: Urticaceae), the flowers and flower buds of which were first recorded as a host plant by M. DeBaar (in Braby 2016). In May 2022, I observed a larva feeding, not on flowers, but on young *Pipturus* leaves in my

garden (Figs 6, 7). Another recent finding is the use of flowers and foliage of Brown Kurrajong (*Commersonia bartramia*: Byttneriaceae), with five larvae collected from a tree in the Norman Creek Catchment, Brisbane, and these were successfully raised through to adults by H. Schwencke (Moss 2020) on flowers and foliage. Additionally, at Woodfordia in south-eastern Queensland, Schwencke (2015) found *Rapala* larvae feeding on flowers of *Acacia maidenii* (Fabaceae). More remarkably, Schwencke (pers. comm.) recently found larvae feeding openly on the epidermis and underlying flesh of Loquat fruit (*Eriobotrya japonica*: Rosaceae); previously reported as feeding only on flower buds and flowers (Braby 2016). Having several suitable host plants for this butterfly in my garden, I find that the Millaa Millaa Vine (*Elaeagnus triflora*: Elaeagnaceae) first recorded as a host by Schwencke and Jordan (1997) is the most favoured. Known to feed chiefly on its flowers, I found that larvae will also develop successfully on soft, fresh *E. triflora* leaves. On one occasion I found a mature larva that had fed on a fresh stem, despite an abundance of nearby fresh leaves (Fig. 17). This larval use of juvenile foliage is possibly the reason *Rapala* continues to breed at certain times of the year when suitable host flowers are not available in my garden.

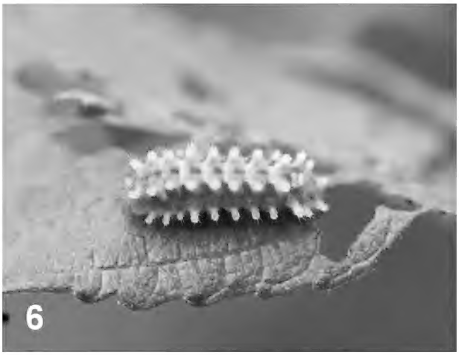

Fig. 6. Larva with chewing *P. argenteus* leaf

Fig. 7. Larva resting on *P. argenteus* leaf

Biology

Flight characteristics vary between the sexes. Males establish territories and have a very rapid flight and perch on the outer margin of leaves with head facing slightly downwards. The females have a slower, less directional flight when flying around the host plants. Females often settle on the upper-side of leaves facing any direction and alternate between walking about and resting for short periods, before taking flight again. Adults of both sexes have been observed feeding on the blossom of *Alphitonia excelsa* (Rhamnaceae) (Lambkin 1983). On several occasions, during

early morning, I have observed females settling on mown lawn, to imbibe moisture (Fig. 8). When feeding, the wings usually remain closed, but may be opened briefly, and particularly in direct sunshine. The life history of *R. v. simsoni* was originally described by Lambkin (1983), who recorded larvae feeding on the flower racemes of *A. excelsa* in Brisbane.

Fig. 8. Resting adult female on lawn

At Beaudesert, south-eastern Queensland, in April 2022, a female was observed ovipositing on a large *E. triflora* vine growing in my garden. She settled on a leaf and then walked onto the stem and around the leaves with wings closed until a suitable location was found. The abdomen was curled onto the stem at the leaf attachment and a single egg was laid. This pattern was continued several times. Although some flowers and young developing fruits were present, females preferred to lay eggs at the petiolar attachment of older leaves where new growth was just starting to develop (Figs 9, 10, 22). Interestingly, I have not observed any eggs being laid on fresh leaves. On one occasion an egg was laid next to a blemish on the upperside of a mature leaf, in the central area of the leaf. During autumn in south-eastern Queensland females have been observed ovipositing between mid-morning and mid-afternoon in sunny or light cloudy conditions, and males are active around midday until mid-afternoon.

Early Stages

Freshly laid eggs are pale green (Figs 9, 10) fading to white within a few days. They are approximately 0.3 mm high × 0.4 mm wide, mandarin shaped with a pattern of pits and small ridges with truncate projections at the pit junctions (Lambkin 1983, Braby 2000). The following larval observations were made when raised on *E. triflora* leaves. First instar larvae did not consume the eggshell and were located within young soft curled leaves which they skeletonize. Larger larvae ate sections from the edge of leaves or holes through the leaves and were observed feeding during the day, but were more active feeding at dusk. They were seen resting either in a curled position along stems or within live distorted leaves caused from feeding. They completed five instars and reached a length of 16 mm. But note that, visually, consecutive instars can be difficult to identify (Figs 11–16). Larvae are well camouflaged with multiple dorsal and lateral fleshy tubercles breaking up their general outline (Figs 14–16, 18). Larvae are mostly not attended by ants

(Lambkin 1983), although on one occasion I observed a small black ant that was investigating a larva (Fig. 18). Pupae are brown and measure 13 mm in length (Figs 19–21). They are usually found, attached by anal cremaster and a central silken girdle, amongst dead leaves caught up in the host plant. Additionally, larvae have been reported to pupate loosely in leaf litter on the ground (Braby 2000). Total life cycle durations, from egg to adult in Beaudesert during April – May, were egg 6 d, larval 27 d, and pupal 14 d. Adults in captivity emerged at dawn and were ready to fly at sunrise.

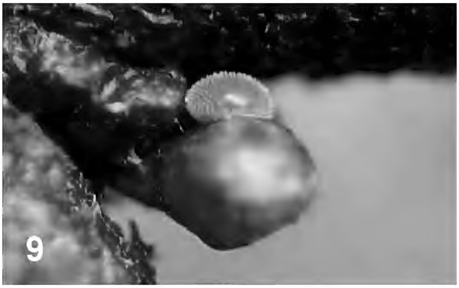

Fig. 9. Egg Lateral

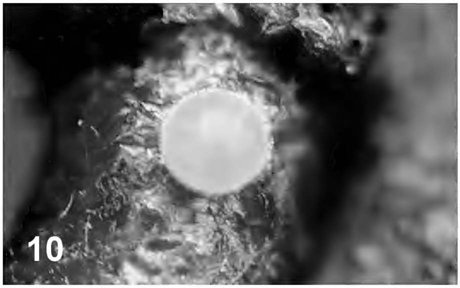

Fig. 10. Egg Dorsal

Fig. 11. Larval instar 1

Fig. 12. Larval instar 1 with chewing *E. triflora* leaf

Fig. 13. Larval instar 2

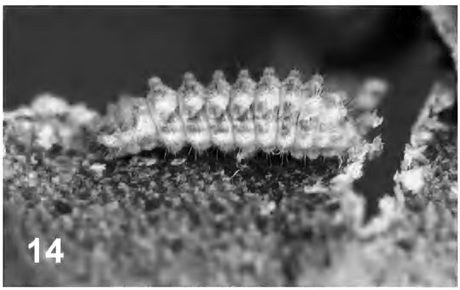

Fig. 14. Larval instar 3

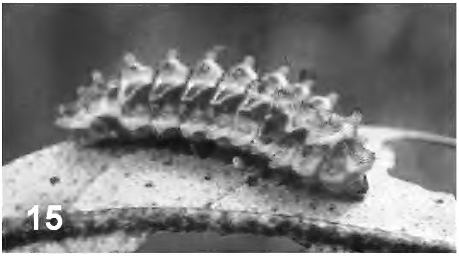

Fig. 15. Larval instar 4

Fig. 16. Larval instar 5

Fig. 17. Larva with chewing *E. triflora* stem

Fig. 18. Mature larva with small black ant

Fig. 19. Pre-pupa

Fig. 20. Pupa lateral

Fig. 21. Pupa dorsal

Fig. 22. Female ovipositing (unsuccessfully)
Note: small pale "egg-like" structures are part of the plant.

Fig. 23. Resting adult female

Comments

Within the boundary of the Scenic Rim Regional Shire, south of Brisbane, *R. varuna* has recently become increasingly common particularly during late March until early June, although virtually absent in the colder months of July and August. Interestingly, I had not seen the species in this shire until 2006, where they were observed at my residence and subsequently at several other sites around the Scenic Rim. This period also coincides with G. Newland's records from near Murwillumbah during 2006. In this region I have adult records monthly throughout the year except for July and November. Although I consider this butterfly mainly a tropical species, the larvae (probably pupae) and adults will survive very light local frosts. There are perhaps two or three generations per year in this region, which likely depends on rainfall and, depending on the host, the availability of fresh growth and flowers.

It is now obvious that *Rapala varuna*, originally thought to feed only on flowers and flower buds of a limited number of host plant species, is able to both survive and reproduce in the absence of the inflorescences. It appears to manage this by having a larger host choice than was initially realised, by resorting to feeding on young leaves of some host plants and, in at least one case, on the fruit of an exotic plant. While the soft fleshy tubercles of the larvae of this species may be a protective cryptic adaption to feeding on flowers and flower buds (as also appears to be the case with several other lycaenid species), larval structure may not be a hindrance

for the survival of some individuals, when alternatively feeding on foliage. It would be an interesting (but difficult!) study to compare predation and parasitism rates for each host type.

Acknowledgements

I thank John Moss for additional suggestions, and his further assistance in alerting me to other observations (including new host plants) as well as finding extra references. Thanks also to an anonymous reviewer for suggested amendments to the manuscript, and to Helen Schwencke and Greg Newland for permission to include their unpublished records.

References

Braby, M. F. 2000. *Butterflies of Australia: their identification, biology and distribution.* Pp. xx + 976 pls 70. CSIRO Publishing: Collingwood, Melbourne.

Braby, M. F. 2016. *The complete field guide to Butterflies of Australia.* Second Edition. 384 pp. CSIRO Publishing: Clayton South, Melbourne.

Corbet, A. S. and Pendlebury, H. M. 1992. *The Butterflies of the Malay Peninsula.* 4th edition revised by J. N. Eliot. 495 pp. Malayan Nature Society, Kuala Lumpur.

Lambkin, T. A. 1983. The early stages of *Rapala varuna simsoni* (Miskin) (Lepidoptera: Lycaenidae) from south-eastern Queensland. *Australian Entomological Magazine* **10** (4): 56–58.

Moss, J. T. 2020. *Butterfly host plants of South-east Queensland and northern New South Wales*. Revised fourth edition. 89 pp. Butterfly & Other Invertebrates Club Inc.

Parsons, M. 1998. *The Butterflies of Papua New Guinea: their systematics and biology*. 736 pp. + 136 pls. Academic Press, San Diego, London etc.

Sankowsky, G. 2020. *A field guide to Butterflies of Australia: their life histories and larval host plants*. 400 pp. Reed New Holland Publishers: Sydney, Auckland.

Schwencke, H. 2015. Indigo Flash (*Rapala varuna*): what is it with their caterpillars? *Metamorphosis Australia*. **79**: 31–32.

Schwencke, H. and Jordan, F. 1997. A host plant for the Indigo Flash (*Rapala varuna*). *Butterfly & Other Invertebrates Club Inc. Newsletter*. June 1997, **6**: 11.

Why we make collections of natural history specimens, especially insects

Trevor A. Lambkin

Introduction

The Natural History Museum in London, at last count, was credited to hold a staggering 12.6 million pinned Lepidoptera specimens, with another one million papered specimens, the total occupying 80,000 drawers in cabinets. The specimens date back over 300 years and of course contain immense numbers of historical specimens, including the first specimens of butterflies collected in Australia by Sir Joseph Banks, enroute Captain James Cook's voyage of discovery, while mapping the eastern coast of Australia.

With so many preserved natural history specimens in the Natural History Museum alone, one may ask the questions, why keep a collection of insects and how is it so that these animals preserve so well, with most just in a dried state adhering to an insect pin in a drawer of a cabinet. Thus, in this work I will attempt to address these two questions.

Why we make collections of natural history specimens

All the drawers of insects housed in museums contribute greatly to our understanding of their still-living brothers and sisters. For this reason, collections are vitally important for studying and identifying these living insects, but not just for documenting biodiversity, but also for developing conservation strategies for our invertebrates, in a world that seems to have little regard for these empires that run the world (to quote Oliver Milman in his recent book: *The Insect Crisis*). In truth, almost all our knowledge of invertebrates comes from their collection and housing in museums for study.

Making a collection of natural history specimens, particularly insects (Fig. 1), fosters an appreciation of the beauty of these creatures and leads to an understanding of them and their ways. I am firmly of the belief that collecting is, in itself, a conservation measure. Therefore, one only needs to visit any museum's insect collection to appreciate that these drawers of insects are a modern-day tool to use for the conservation of their living relatives.

Why are insects easy to preserve?

Insects are just so designed that they can be collected, prepared, and maintained with little or no preservation. Because of their external skeleton, they endure for

centuries (Fig. 2). In addition, insects are very different to vertebrates, not only in their structure with their skeletons on the outside, but also in their sheer number, of species and individuals. Insects are generally short-lived, they reproduce quickly and therefore, collecting several individuals of any species has no detrimental effect on a population. In fact, it is well documented that collecting insects has little to no effect on populations of insects, compared to the detrimental and terminal effect of land clearing. Furthermore, butterfly collectors, for example, most often collect the immature stages of butterflies and successfully rear these stages through to the adult butterfly. These butterflies would not normally reach maturity, as only about two percent of butterfly eggs laid by a fertile female butterfly successfully emerge as butterflies with the bulk of the immature stages falling prey to spiders, parasitoids, wasps, and birds. The rearing of these butterflies by collectors has provided all our knowledge on the biology, early stages, and hostplant relationships of the Australian species. Without this collection and preservation of Australia's butterflies for example, very little would be known and documented of these special creatures.

Fig. 1. Collection of some Australian Nymphalid butterflies

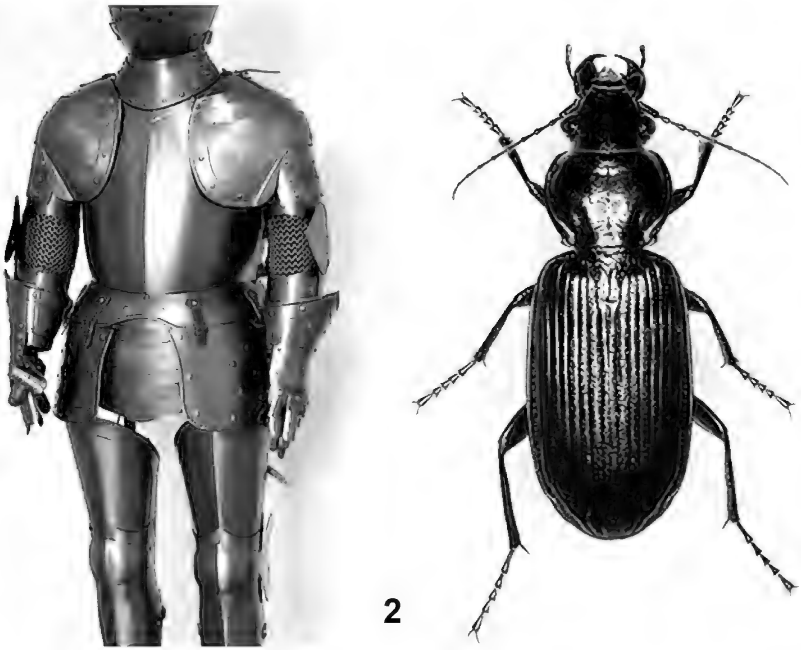

Fig. 2. The hard exoskeleton of an Australian Carabid beetle, analogous to the armour of a knight

When did it all start?

The science of natural history collecting really commenced with the formation of the Royal Society in England in 1662 (Fig. 3). After this, around a century later, the Swedish scientist Caroli Linnaei developed the binomial system of classifying organisms of the Animal Kingdom in his *Systema Naturae* Edition 10, published in 1758. Later that century Fabricius, who was a student of Linnaei described many of the animals brought back to England from eastern Australia by Sir Joseph Banks from Cook's voyage of discovery.

Some history of butterfly specimens

The oldest known pinned insect specimen is a Bath White butterfly (*Pontia daplidice*) (Lepidoptera: Pieridae), collected near Gamlingay, Cambridgeshire in May 1702 (Fig. 4). The specimen is currently in the Oxford University Museum of Natural History, Oxford, UK. The first butterfly collected in Queensland was a Blue Tiger (*Tirumala hamata*) (Nymphalidae), collected on 29 May 1770 from Thirsty Sound, near Rockhampton during Cook's voyage (Fig. 5). This specimen is housed in the Hunterian Museum in Glasgow, England.

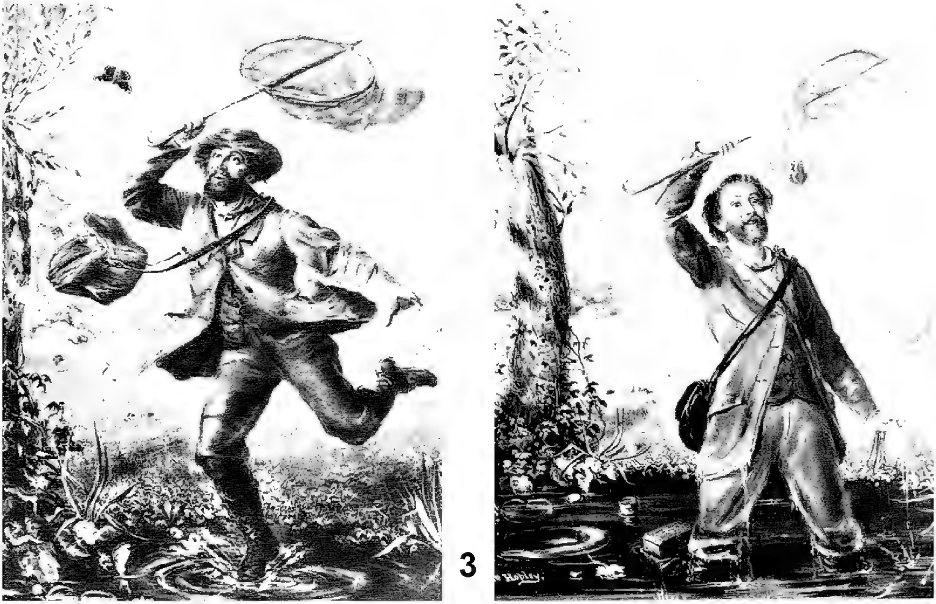

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Fig. 3. 'The Chase' and 'Bagged': two small paintings by E.W.J. Hopley (1816-69) (courtesy of The Aurelian Legacy, M.A. Salmon)

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Fig. 4. Bath White butterfly (*Pontia daplidice*), ex. Gamlingay, Cambridgeshire, May 1702

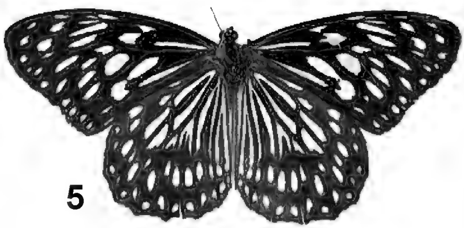

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Fig. 5. Blue Tiger (*Tirumala hamata*), ex. Thirsty Sound, 29 May 1770

Scientific value

Proper preparation of insect specimens for museum housing is critical for their long-term preservation. One of the most important aspects of forming a collection of insects is their correct labelling (Fig. 6). Without such labels, insect specimens have no value. Additionally, insects that are properly set and labelled, rather have a strong scientific value (Fig. 7). Properly labelled specimens are time capsules of the past to be used for present and future conservation studies.

Fig. 6. Correctly labelled specimens of *Argynnis hyperbius inconstans*, ex. Queensland

Other benefits

We cannot assist our biodiversity if we are unaware of what our biodiversity is. Thus, documenting and studying insect collections are vitally important, so museum collections are storehouses for information generated by researchers who study the natural world. Natural history collections constitute the single largest source of information on Earth's biological diversity. Most of what we know about invertebrates, when and where they occur, is derived from museum collections, accumulated over the past three centuries. Additionally, based on studies of invertebrates, we

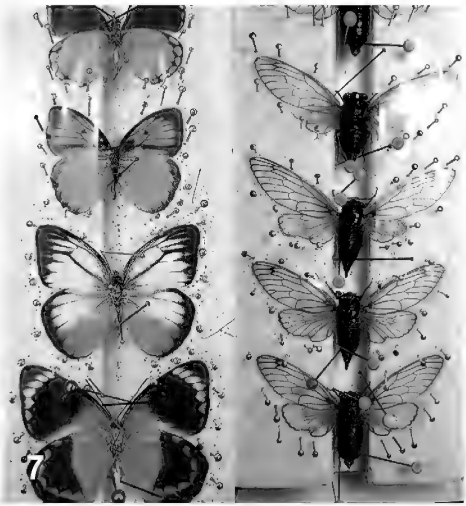


Fig. 7. Set specimens of butterflies from Timor, and cicadas from the United States

gain a better understanding of zoogeographic relationships of faunas and can make predictions of animal distributions. Moreover, of relevance today is developing a baseline for monitoring the effects of climate change and sea level rises on our fauna and flora. Perhaps the most significant outcome of making a collection of insects is that from young collectors, entomologists are born.

Finally, based on current social ideas, it may seem inappropriate to suggest that collecting insects should be encouraged, but what I am endorsing again is that making a collection of insects is really a form of conservation. It is by collecting insects and preserving them in museums, it is our hope for conservation of the future. Thus, the benefits of collecting museum specimens for future generations far out ways any detrimental effect or stigma that our current society attempts to label this discipline of science.

Austroplebeia australis, a perfect Australian bee

Dean Haley

Stingless bees are a large group of bees found in the tropical and subtropical regions of the world including the Americas, continental Asia, south-east Asia, India, sub-Saharan Africa, and Australia. They are genetically diverse with more than 600 species worldwide in 50 recognized genera (Heard 2016).

Scientifically, these bees are described by Family: Apidae, Clade: Corbiculata, Tribe: Meliponini. In common usage though, they are 'Stingless Bees' due to the peculiar characteristic that these bees have lost their sting in the distant past. Throughout the world they have various names in the local languages, and are valued for their honey for food, and for traditional medicinal uses.

Australia has 11 recognised species of native honey bees belonging to just two genera, Genus *Tetragonula* or Genus *Austroplebeia.* Of these, *Tetragonula* (with a total of 31 species) are found throughout India, Asia, Micronesian Islands (Pulau, Caroline Islands), South Pacific Islands (Solomon Islands), and Australia (Rasmussen 2008). Australia has six of these species, of which, four are endemic to Australia. This includes the highly popular *T. carbonaria* (Smith, 1854) found throughout coastal Queensland (QLD) and New South Wales (NSW) with its beautiful spiral brood pattern. This is the bee species most commonly kept in Australia for pollination, honey, and as a cool pet... but it's not my favourite.

Austroplebeia is the other genus which calls Australia home. Of the five recognised species, four are endemic to Australia, and the fifth is found in both Australia and New Guinea. My favourite Australian stingless bee is *Austroplebeia australis* (Friese, 1898). This species has widespread Australian distribution being found in NSW, QLD, Northern Territory (NT), and northern Western Australia (WA). It has the widest distribution of any stingless bee in Australia, and is found in drier, more inland country than its distant *Tetragonula* relatives. They are found near Cobar in western NSW; near Mt Isa in western QLD and can be even be found in Alice Springs, NT, (Atlas of living Australia, http://ala.org.au accessed 24/06/2022).

The ability to live in these drier regions shows a remarkably adapted bee, able to withstand droughts that sometimes last for years. During drought, the hive must subsist entirely on the honey and pollen collected during wetter years.

Indigenous Australians have sustainably managed stingless bees for thousands of years, and have incorporated them into cultural, spiritual, and totemic systems. Recognition of stingless bees can be found in First Nation's song, dance, paintings,

and certain patterns used in weaving. Through cultural laws and systems, the bee resource was carefully managed to prevent over-exploitation (Akerman 1979, Fijn 2014, Si and Carew 2018)

A survey performed in 2020 (Sajith 2021) recorded 11442 stingless bee colonies kept by 1448 stingless bee keepers, with only seven percent of these being *A. australis*. The figure shows that these bees are under-utilised compared to their *Tetragonula* cousins. The reasons may be availability of hives for sale, slower colony growth rates, smaller colony size, or difficulty propagating new hives. Certainly, the hives are smaller in nest volume and total forager numbers than *T. carbonaria*, which may make them less attractive to farmers and orchardists interested in keeping stingless bees for pollination.

Despite the issues listed above, I think that *A. australis* has great potential. The bees are shy, peaceful, and quiet to handle. I can open a hive of *A. australis* while sitting inside on my lounge chair (better than television in my opinion), and the bees do not flood out in defence, but carry about their business tending honey-pots or brood. If a worker eventually walks to the top of the hive to find out where the lid has gone, I can easily wave a finger at her and she will go back down. The gentle nature and tractability of *A. australis* is in stark contrast to *T. carbonaria* where defending bees will crawl in your ears, eyes, and nose biting with their mandibles. Every *A. australis* keeper I know is similarly in love with their gentle nature. *Austroplebeia australis* is a truly gentle, stingless bee and is the perfect pet.

While *A. australis* is now recognized as the most widespread species of Australian stingless bee, it wasn't always the case. Up until 2015 it was believed there were five species: *A. australis* (Friese, 1898), *A. cockerelli* (Rayment, 1930), *A. ornata* (Rayment, 1932), *A. percincta* (Cockerell, 1929) and *A. websteri* (Rayment, 1932). Dollin et al. (2015) revised this, based on morphological examinations and concluded it is just one species (*A. australis*). But watch this space… researchers are now starting to delve into the genetics of Australian stingless bees and this may result in new knowledge of reproductive isolation, and recognition of multiple species. Exciting times ahead!

A. australis *Characteristics*

Workers

A. australis workers are four millimetre in length and are usually black, with tiny cream-coloured half-moons or stripes on the thorax. The abdomen is usually black, though dark brown, orange, and red colour morphs are sometimes seen (Dollin et al. 2015), and different colours can even be seen in the same hive.

Queens

Queens are two to three times the length of workers and their abdomen may become quite distended with eggs. The abdomens of most queens I see are orange, even when the workers in the hive are black, so it is easy to spot the queen. The legs of queens are often a brown or orange colour as well, in contrast to workers who always have black legs.

Drones

Drones or male bees are also black and are the same body length as workers. They can be seen within the hive and generally hang out with other males in the periphery of the colony. Under a hand lens, differences can be seen in the male's head, especially in the shape of the eyes. The males hold their body position differently to workers, with the tip of the abdomen down and head up the males remind me of tiny rabbits, which is how I recognise and observe males within the colony.

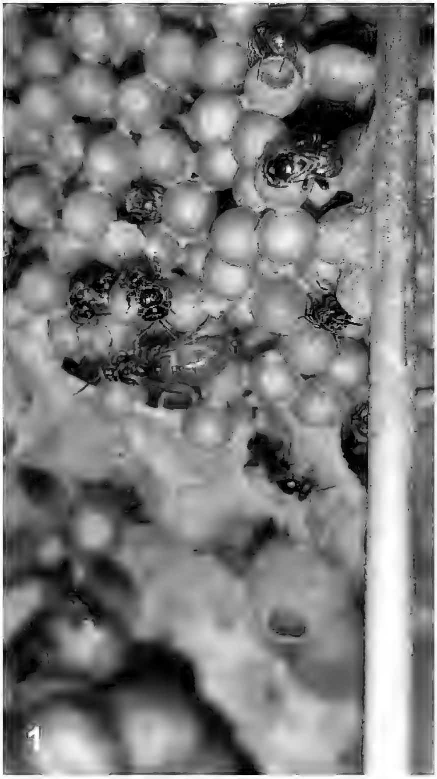


Fig. 1. Queen on brood structure (photo credit Alex Derrick)

A. australis *nest*

A. australis construct their nests in hollow trees. Most nests will be found in branches high up in trees, though some nests will be found in the main trunk of small trees. The hollow that *A. australis* prefers is narrow, about five to eight centimetres in diameter, though they will sometimes form nests in cavities slightly larger. Total nest volumes are estimated between three and eight litres, which means that very narrow cavities can be very long to reach the required volume. I have personally seen nests which are four metres long.

A. australis nests are constructed in tree cavities sealed at both ends by tough, perforated plates constructed of wax, resin, mud, and even bee excrement. The entrance of *A. australis* nests is fashioned into a tunnel or tube which may extend for 20 cm internally and up to 10 cm externally, sticking out like this it is called a nose in some Australian indigenous languages (Si and Carew 2018). The entrance

tube is important to the bees, it provides a place for defense against invaders, and is used for ventilation, and possibly humidity control (Beil 2016), and possibly evaporative temperature control of the nest by placing droplets of water in the tube and blowing air over these droplets with wing flapping (Beil 2016). Pollen pots are spherical structures built from bees wax being approximately half a centimetre in circumference. Pollen pots are stored close to the entrance of the colony, and piled up against each other like bunches of grapes. Brood consists of a ball of loosely aggregated cells, that ranges from the size of a tennis ball, to the size of a grapefruit.

Brood balls are usually found close to the entrance of the colony but could be found further away depending on the internal geometries of the tree cavity. If the colony is in a large diameter tree cavity there will be a single brood ball, If the colony is in a narrow cavity, there will be two, three, or four brood areas and the Queen will travel between them to lay eggs as required. Honey pots are the same size as pollen pots and may be built above or below, or intimately surrounding the brood area. Importantly, I believe the honey pots in close proximity to the brood area are used to control humidity in a desired range. I observe the bees opening or closing honey pots in response to changes in external temperature and humidity. Tight control of hive humidity has been experimentally observed in another *Austroplebeia* species (Ayton 2016), but the mechanism of opening and closing honey pots has not been previously reported.

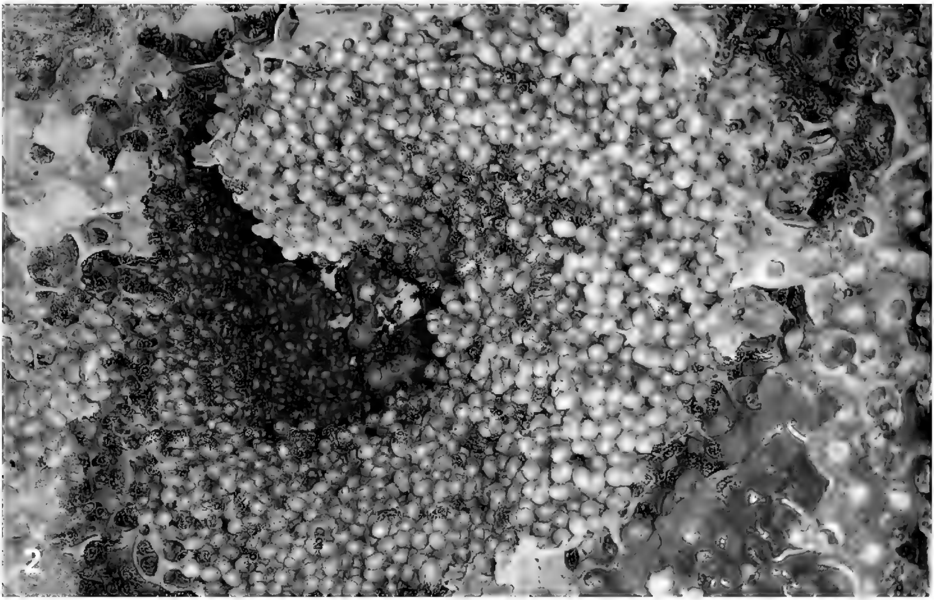


Fig. 2. Brood ball of loosely aggregated cells

As previously mentioned, *A. australis* colonies are sometimes many metres in length, though the internal chamber is very small. These peripheral areas far away from the brood are filed with honey pots, and I have never observed pollen stored there. There are some final characteristics which can be observed in australis nests. Considerable open-air spaces exist, which may assist with ventilation purposes. There are rubbish accumulation areas near the internal entrance tunnel. Rubbish can be piled here for many days before it is carted outside, especially in cold winter temperatures. Separate to the rubbish areas, are internal latrines where bees defecate. Nick Powell has observed baby bees (Callows) rolling in the latrine area soon after hatching (Powell 2016), and theorizes that this may be a method of inoculating themselves with beneficial micro-organisms, while Ayton (Ayton 2016) theorized that high levels of uric acid present in the latrines may act as a desiccant and thereby aid in nest humidity regulation. Finally, there is a ball of resin which is deposited to the side of the entrance tunnel. This ball of soft resin is about the size of a fishermen's friend cough lolly, and is used nightly to close the colony entrance, with a structure reminiscent of a screen door.

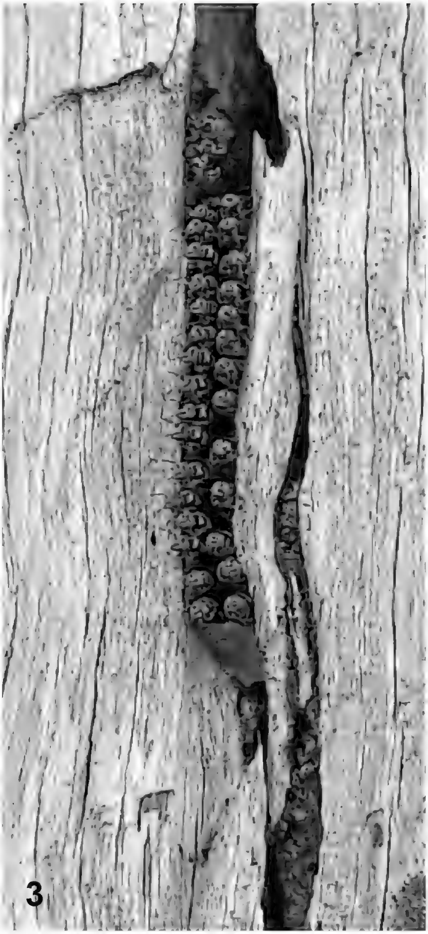


Fig. 3. Guards at the log entrance (photo credit Alex Derrick)

Stingless Bee Honey

A.australis store about 500 g of honey per year, which is not very much when you compare it to *T. carbonaria* which can make 2 kg per year. Nevertheless, it is delicious, and reminds me of lightly roasted toffee, or a subtle marmalade. It is the perfect nectar of the Gods, being neither sickly sweet (like *Apis mellifera* honey), or bitter/sour like *Tetragonula carbonaria* honey.

The Australian Native Bee Association is drafting an application to Food Standards Australia/New Zealand to have Australian stingless bee honeys recognized as food. This will help stingless bee honey reach the shops to be enjoyed by the public.

Acknowledgements

I would like to thank Alex Derrick for the use of his images, Queen on the brood structure and Guards at the log entrance.

References

Akerman, K. 1979. *Honey in the life of the Aboriginals of the Kimberley*, Oceanea, XLIX No 3.

Atlas of Living Australia http://ala.org.au

Ayton, S., Tomlinson, S., Phillips, R. D., Dixon, K. W., Withers, P. C. 2016. *Phenophysiological variation of a bee that regulates hive humidity, but not hive temperature* Journal of Experimental Biology 219(10)

Beil, Allan. 2016. *Personal communication.* Tara, QLD

Dollin, A. E., Dollin, L. J., Rasmussen, C. 2015. *Australian and New Guinean Stingless Bees of the Genus Austroplebeia Moure (Hymenoptera: Apidae)-a revision. Zootaxa, 4047*(1), 1–73.

Fijn, N. 2014. *Sugarbag Dreaming: the significance of bees to the Yolgnu in Arnhem Land, Australia.* HumaNIMALIA 6:1, 41–61.

Heard, T.A. 2016, *The Australian Native Bee Book – Keeping stingless bee hives for pets, pollination and sugarbag honey*

Powell, Nick. 2016. *Personal communication.* Tarragindi, QLD

Rasmussen, C. 2008. *Catalog of the Indo-Malayan / Australasian stingless bees.* Zootaxa 1935:1–80

Sajith, S. 2021. *3rd National Stingless Bee Survey Completed.* The Cross-Pollinator, Issue 19, Newsletter of the Australian Native Bee Association.

Si, A. and Carew, M. 2018. *Stingless Honeybee (Sugarbag) Naming, Identification and Conceptualization in Arnhem Land – A lexicographic approach.* Australian Journal of Linguistics, volume 38:4, 519–548

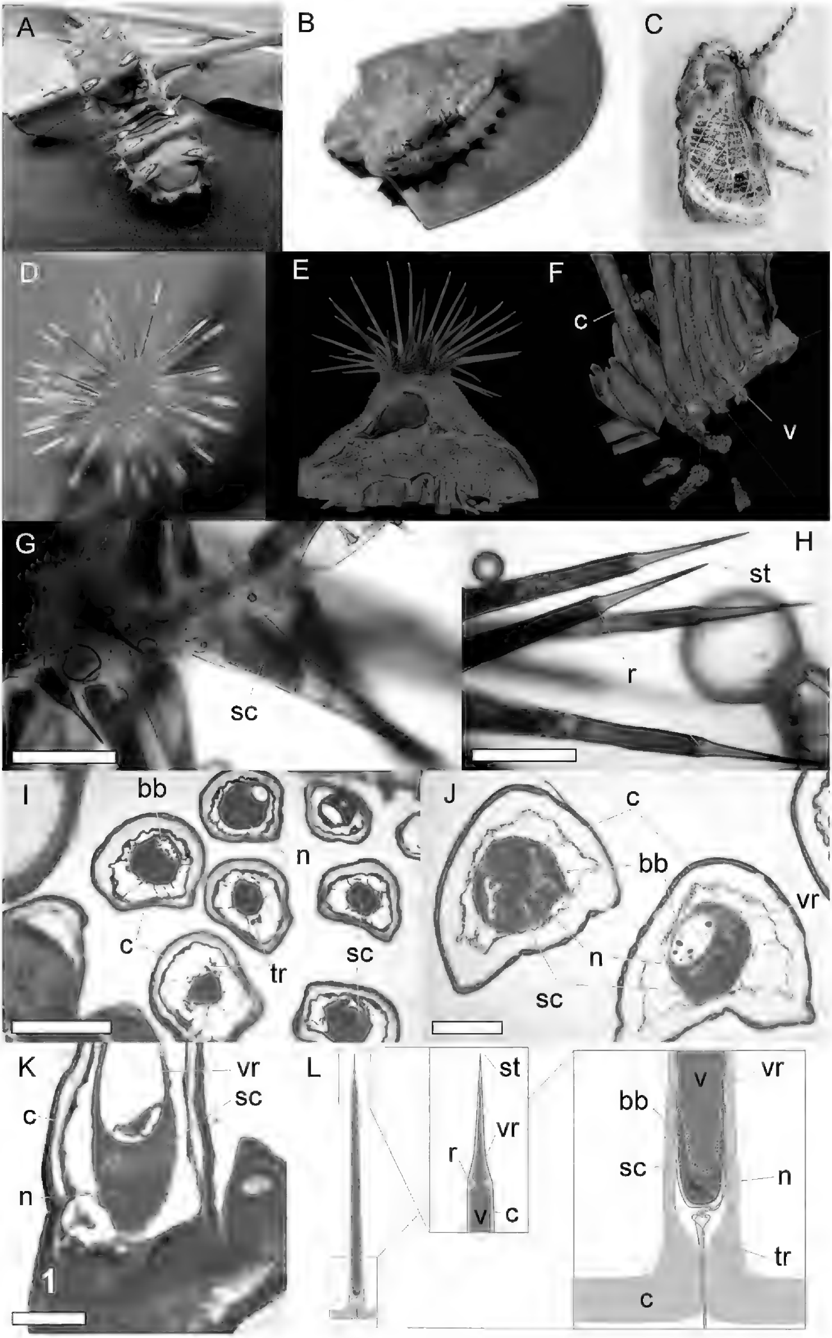
Australia's venomous limacodid caterpillars

Andy Walker

The lepidopteran family Limacodidae occurs on every continent except Antarctica, and we are lucky in Australia to have numerous species that possess some remarkable biological features. Moths in this family are commonly known as cup moths, reflecting their distinctive cup-shaped pupal cocoons. Some are also known as nettle caterpillars, which reflects their use of defensive venom to protect the vulnerable larval stage against predators. One of the first records of Limacodidae by Europeans in Australia was, amusingly, made by Joseph Banks after being painfully stung by *Doratifera stenora* in a mangrove forest near what is now Seventeen Seventy (Burwell and Edwards 2003). He described the caterpillars as a 'wrathfull militia'. However, not all limacodid caterpillars are 'nettles'! The larvae of *Chalcocelis albiguttatus*, are 'jellies' that are smooth without spines and thus, lack venom.

I first became interested in this family of moths while collecting insects with the Entomological Society of Queensland near Toowoomba. I was hoping to get some assassin bugs (Hemiptera: Reduviidae) for our studies into their venom at The University of Queensland, and in addition to several reduviids, someone on the trip collected a late instar *D. vulnerans* (Fig. 1) which was saved for me on the advice of Geoff Monteith who advised it had a painful sting. However, by the time I got that specimen back to the lab for analysis, it was no longer a caterpillar. It had built itself a small round cocoon, which mimics very well the gumnuts that are found on their *Eucalyptus* host plants – a reminder to me that evolution and biology are constantly surprising.

Fig. 1 (opposite). Morphology and venom apparatus of the limacodid caterpillar *D. vulnerans*. (A) Final instar caterpillar in resting posture with spines folded against body, length ~25 mm (Image credit: Mount Gravatt Environment Group); (B) Final instar caterpillar in defense posture with eight scoli of everted venom spines; (C) Nonvenomous adult moth, length ~18 mm (Image credit: Flickr/ Ian MacMillan), (D) Left anterior-most venom scolus, ~6 mm across, (E, F) μ-computed tomography reconstructions of fixed specimens: (E) Venom scolus and surrounding tissue; (F) Venom spines showing venom (v, blue) and cuticle (c, green); (G, H) Light micrographs of shed exuviae (Scale bar, 100 μm.): (G) Base of venom spines with secretory cell (sc) visible, (H) Distal ends of spines with rings (r) and spine tips (st); (I–K) Light micrographs of resin-embedded specimens: (I) Slice through the base of spines, secretory cells (sc) with associated trachea (tr) encased in cuticle, with nuclei (n) and brush borders (bb) visible (Scale bar, 100 μm.), (J) Higher magnification micrograph through base of spines with venom reservoir (vr) visible (Scale bar, 40 μm.), (K) Slice through base approximately longitudinal to spine, showing cup-shaped secretory cell. (Scale bar, 40 μm.); (L) Schematic of an individual spine and its functional anatomy for the production, storage, and delivery of venom (green) (Reproduced from Walker *et al*. 2021).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As it turned out, when that cocoon opened it was not a moth, but a parasitic tachinid fly that emerged from it – a reminder that while I knew that evolution and biology were weird and surprising, they are always nonetheless, much weirder and surprising than I could imagine. Despite their venomous protection, attempting to collect and keep limacodids has made me aware that high percentages of parasitism by tachinid flies (close to 100% in many samples) and other parasitic wasps seems to be a common feature for many limacodids. They are also susceptible to viruses that lead to tissue blackening and liquefaction, which sometimes wipe out entire captive colonies.

The name *Doratifera vulnerans*, as far as I can tell (and no one has corrected me yet), is a mixture of Greek and Latin that means something like 'bearer of gifts of wounds'. The genus *Doratifera* is one of several groups within Limacodidae that have the ability to tuck their spines away and evert them only when threatened, which presumably is an adaptation to stop the premature loss of venom when the caterpillar accidentally bumps against a harmless surface as gently brushing the tips of the spines is enough to break the spine tips and discharge the venom.

We have used *D. vulnerans* as a model system for limacodid venoms and have undertaken much work to describe the biochemistry and pharmacology of its venom and how it is produced (Walker *et al*. 2021). Venom studies or "venomics" is an expanding field, driven by recognition that venom toxins have properties that are often useful as scientific tools, in medicines, or biopesticides. For example, toxins are instrumental in discovering many physiological processes in health and disease (Israel *et al*. 2018, Beneski and Caterall 1980) with some venom-derived molecules already the basis of available medicines (King 2015). More are in the pipeline, including some from the Queensland invertebrate fauna such as the Darling Downs funnel-web, *Hadronyche infensa*, which produces a venom peptide entering clinical trials to treat stroke and improve heart transplant (UQ News July 2022). Synthetic spider venom toxins are also available as bioinsecticides with potential to improve environmental outcomes and target pests instead of beneficial insects (C&EN March 2017). Australia's limacodids may produce molecules in their venom with similarly exciting applications (The Guardian June 2021). However, we are not up to the stage of applications yet as currently, we are just at the early stages of understanding what is in the venom of a handful of species, and how it underlies the ecological role of the venom, which is to protect larvae from predation.

In the course of this work, it has been a pleasure to discover many other things about limacodid caterpillars. However, it is obvious even to me (a molecular man rather than an expert in entomology or ecology) that much remains to be learned

about our Australian limacodids. While larvae of the genus *Doratifera* (apart from *D. stenora*) primarily feed on *Eucalyptus* foliage, they are not fussy for a caterpillar, apparently content feeding on any *Eucalyptus* species, and *Corymbia* too. For some other species of limacodids, for example *Anaxidia lozogramma* (Fig. 2), the host plants are poorly known, at least in the scientific literature that I am aware of. I was initially introduced to *A. lozogramma* in the context of feeding on blueberry bushes near Beerwah, where it was doing a good job of traumatising a local organic farmer, who was also a keen amateur entomologist and a keeper of native bees. He was routinely stung by *A. lozogramma* while harvesting blueberries and described the sensation 'like being electrocuted'. In the days before I visited, he had been repeatedly stung and had donned a pair of gloves to complete the harvest that day, only to be stung shortly afterwards in the face. Scouring the literature for a native hostplant of *A. lozogramma* suggested *Macadamia* as a possible hostplant. The first batch of caterpillars I collected from the blueberry farm I attempted to feed macadamia leaves and they all died, but perhaps the plant I had purchased had been recently sprayed with insecticide. So, figure my surprise when one of my students turned up recently with a late instar *A. lozogramma* from Brisbane that she had found feeding on *Eucalyptus*. We kept feeding it on *Eucalyptus* and it pupated successfully, but it is still unclear to me what is the usual hostplant for this species.

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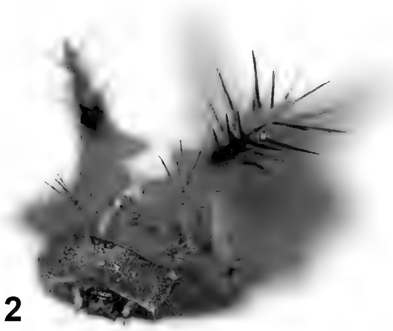

Fig. 2. Final instar larva of *Anaxidia lozogramma* (Photo: Jiayi Jin).

Recently we collected another species from Townsville for venom studies, which is one of the most heavily defended limacodid species I have seen, being entirely covered on its dorsal and lateral surfaces with venomous spines (Fig. 3). This species was first sent to me by Lisa Willcox and identified with the help of Lyn Cook at The University of Queensland as *Comana monomorpha*. Returning to Townsville in 2021 to collect additional specimens, we didn't find any in the first

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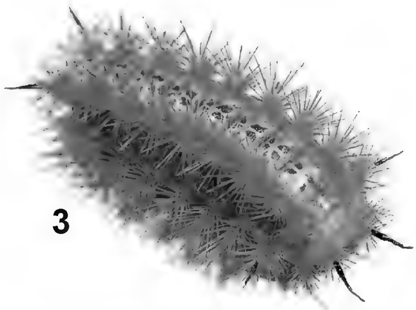


Fig. 3. Final instar larva of *Comana monomorpha*. Note the highly armed morphotype of this species (Photo: Sam Robinson).

few days and I posted a request for help locating them in a Townsville Gardeners' group on Facebook. I was to learn this species is infamous among some local gardeners, one of whom had gone to hospital multiple times with anaphylaxis-like symptoms after being envenomated. Several others who had suffered repeated envenomations described removing–lilly pilly trees (*Syzygium* sp.) for the sole purpose of removing the *C. monomorpha* caterpillars that frequented them. This species is sometimes found on geisha bush (*Durantes repens*) and golden cane palm (*Dypsis lutescens*), although lilly pilly seems to be its most frequent host. Studying its venom biochemistry has been interesting, as it produces venom quite different in composition from *D. vulnerans*. It is unknown whether or not this more heavily defended morphotype is related to its different venom composition.

We (PhD student Deseh Goudarzi, my boss Glenn King, and collaborator Marc Epstein, and I, among others) are still working on the venoms of limacodid caterpillars. We are also interested in obtaining more information about their occurrence and host plant preference, as well as describing the morphology of series of instars and adults to learn more about the evolution of their ontogeny. We are particularly keen to acquire some *Thosea penthima* as the phylogenetic position of this species has the potential to inform us about the evolution of limacodid venom in this family. However, we do not require any more *D. casta*, *D. quadriguttata* or *A. lozogramma*. If you have venomous limacodids from your property that you would like to donate to science we would be very grateful to receive them.

Dr. Andrew A. Walker is a postdoctoral researcher at The University of Queensland's Institute for Molecular Bioscience and can be contacted on a.walker@uq.edu.au or 0419712754.

References

Beneski, D. A. and Catterall, W. A. 1980. Covalent labeling of protein components of the sodium channel with a photoactivable derivative of scorpion toxin. Proceedings of the National Academy of Sciences of the USA, **77**: 639–43.

Burwell, C. J. and Edwards, T. D. 2003. The identity of Sir Joseph Banks' "wrathfull militia": The larvae of "*Doratifera stenora*" Turner (Lepidoptera: Limacodidae). Aust Entomologist, **30**: 39–43.

C&EN, March 13, 2017. 'Spider venom: An insecticide whose time has come?' https://cen.acs.org/articles/95/i11/Spider-venom-insecticide-whose-time.html.

King, G. F. 2015. Venoms to drugs: Venom as a source for the development of human therapeutics. Cambridge, UK: Royal Society of Chemistry.

Israel, M. R., Morgan, M. Tay, B. and Deuis, J. R. 2018. Toxins as tools: Fingerprinting neuronal pharmacology. Neuroscience Letters. **679**:4–14.

The Guardian, 23rd June 2021. 'Stinging secret: research reveals how venom from Australian caterpillars could be used in medicines' https://www.theguardian.com/australia-news/2021/jun/23/stinging-secret-research-reveals-how-venom-from-australian-caterpillars-could-be-used-in-medicines.

UQ News, 14th July 2022: 'Deadly spider venom treatment for heart attacks reaches next milestone'

https://www.uq.edu.au/news/article/2022/07/deadly-spider-venom-treatment-heart-attacks-reaches-next-milestone.

Walker, A. A., Robinson, S. D., Paluzzi, J-P. V., Merritt, D. J., Nixon, S. A., Schroeder, C. I., Jin, J., Gourdarzi, M. H., Kotze, A., Dekan, Z., Sombke, A., Alewood P. F., Fry B. G., Epstein, M. E., Vetter, I., and King, G. F., 2021. Production, composition, and mode of action of the painful defensive venom produced by a limacodid caterpillar, *Doratifera vulnerans*. Proc Natl Acad Sci USA. **118**(18): e2023815118.

Treehopper, leafhopper and planthopper observations

Jenny Thynne

Introduction

In our Brisbane Garden I've observed a number of different hopper species, and they are among my favourite insects. They are all sapsuckers, with specially designed mouthparts which pierce the plant cells and suck out the contents of the leaves, twigs, branches or trunks of the host plant or tree. Some have among the highest recorded jumping speeds in the insect world. Leafhoppers, treehoppers and planthoppers belong to the sub-order Auchenorrhyncha of the Order Hemiptera which also includes true bugs, cicadas, aphids and scale insects.

Treehoppers

Horned treehoppers belong to the Family Membracidae and are distinguished by their enlarged "pronotum", the top part of the thorax just behind the head. In some species, the pronotum resembles a thorn, but it can take other bizarre shapes which help camouflage these tiny insects. In most other insects, such as leafhoppers, cicadas, beetles, and bees, the pronotum is just a simple band from one side to the other. Treehoppers are obviously usually found on trees, but because of their camouflage abilities, the majority of ours are most easily seen when they hop onto leaves.

We frequently see the green horned treehopper – *Alosextius carinatus* (Fig.1) and it's one of my favourites. They are quite small, about 5 mm. I find these weird little treehoppers and their nymphs on numerous plants under our *Acacia fimbriata*.

Fig. 1. *Alosextius carinatus* – green horned treehopper

One of the most amazing-looking treehoppers found here is *Lubra spinicornis*, with its two decorated horns. (Fig. 2) It is a small hopper, about 8 mm long, and is like something out of a science fiction movie.

There is another family of treehoppers, Eurybrachyidae, whose members do not have the pronounced pronotum. We often see one species belonging to this family, the green-faced wattle hopper *Hackerobrachys viridiventris* which grows to about 11 mm (Fig. 3).

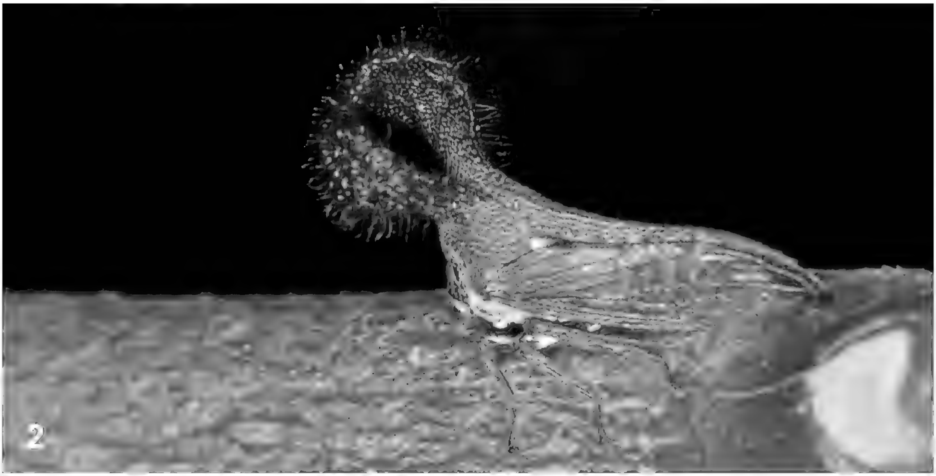


Fig. 2. *Lubra spinicornis*

Leafhoppers

The majority of leafhoppers belong to the family Cicadellidae. We haven't been able to find and identify any leafhoppers in our yard which is surprising, as there are more than **700** species in this family occurring in Australia. Leafhoppers are usually small, wedge-shaped, cicada-like insects. Perhaps they are just too well camouflaged!

Planthoppers

Planthoppers are divided into a number of families, and we are fortunate to have a number of different species visiting the garden.

Fig. 3. *Hackerobrachys viridiventris* – green-faced wattle hopper

The most commonly seen planthoppers here are the Green Flatid Planthoppers – *Siphanta hebes*, (Family Flatidae), as their size 15 mm and almost triangular, flattish shape make them easily visible on twigs and leaves. (Fig. 4) Sometimes they land on our kitchen window at night. This species has been reported as established in Southern California where it's known as the Australian torpedo bug, but it apparently does no harm there.

Fig. 4. *Siphanta hebes* – green flatid planthopper

A very similar species belonging to the same family we've observed here is the Mango Planthopper – *Colgaroides acuminata*. It has the same shape, size and appearance as *S. hebes*, but is a paler green with a tiny but distinctive orange/red spot on each front wing.

Once I found the egg mass of a flatid planthopper on the underside of a leaf (Fig.5). It was only 3 mm in diameter, and covered in a waxy substance.

Another common planthopper in our garden is *Magia subocellata* (Family Lophopidae), known as the palm planthopper (Fig. 6). It grows to about 15 mm in length. We see a few of these beautifully coloured planthoppers and their nymphs on our rhapis palms.

The Brown Ricaniid Planthopper – *Aprivesa exuta* (Family Ricaniidae) – grows to about 15 mm and has been seen on our passionfruit vine but no visible harm was done to the vine. They are very well camouflaged when found on a tree trunk, but easily visible on a green leaf!

Fig. 5. *Siphanta* species egg mass

Fig. 6. *Magia subocellata* – palm planthopper

The largest planthopper we've seen here is *Desudaba aulica* (Family Fulgoridae). It is about 20 mm long and mostly brownish in colour with large cream and brown eyes.

Mutualism

Some hopper species have a special relationship with ants known as obligatory mutualism, a term used to describe a process which is beneficial for the well-being of both species. The ants milk the excess honeydew excreted by the hopper nymphs and in turn help to protect the nymphs from predators. We've observed mutualism on a couple of different hopper species (Fig. 7).

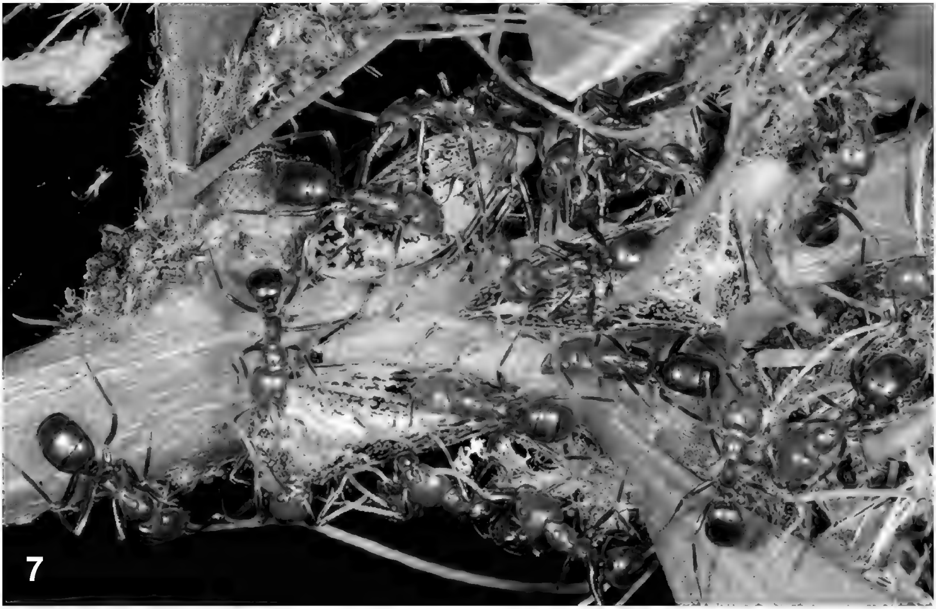


Fig. 7. Mutualism – ants tending unidentified hopper nymphs

Introduced species

In 1995 lantana treehoppers, *Aconophora compressa* (Family Membracidae) were introduced from Mexico to NSW and Queensland as a biological control agent for one of Australia's worst weeds, lantana. These grow to about 8 mm and provide another example of the bizarre pronotum seen in some species (Fig. 8). They have not been used as a control agent since 2001. They also feed on a number of other plant species, one of their favourite hosts being the exotic fiddlewood (*Citharexylum spinosum*), a popular tree in Australia.

A watch is being kept for another exotic hopper, *Homalodisca vitripennis, known as the* glassy-winged sharpshooter. They are large, about 14 mm long, and easily seen with the naked eye. They are endemic to south-eastern United States and north-eastern Mexico. The glassy-winged sharpshooter has a host range of

over 200 plant species, including almond, cherry, citrus, grapes, macadamia, peach, pecan and plum. It has not been found yet in Australia but a close watch is being kept and any sightings should be reported.

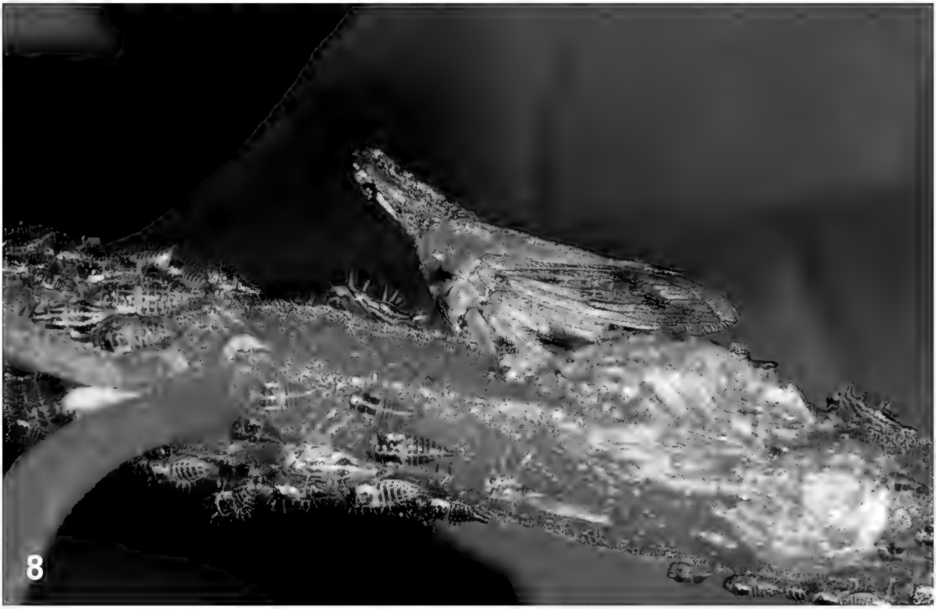


Fig. 8. *Aconophora compressa – Lantana treehopper nursery and adult*

References

Zborowski, P. and Storey, R.W. 2010. *A Field Guide to Insects in Australia*. 3rd edition. New Holland Publishers.

Naumann, I.D. 1991. *Insects of Australia* Hemiptera. pp. 429–509. 2nd edition. CSIRO. (Division of Entomology). Melbourne University Press.

NewsBOIC. Issue No. 26. p. 9.

Biosecurity Queensland: https://www.daf.qld.gov.au/business-priorities/biosecurity.

Brisbane Insects: https://www.brisbaneinsects.com.

An overview of Australia's Ground Beetles (Coleoptera: Carabidae)

Alexander A. Davies

Introduction

The family Carabidae or simply called carabids or Ground Beetles, is one of the largest beetle families, with over 40,000 described species in more than 1700 genera (Slipinski 2013). They are found worldwide, from cold temperate locations such as Canada, Tasmania and New Zealand, to tropical regions like Malaysia and south America (CSIRO 2007). In addition, they occur in deserts like those in Africa and north America, and just about every habitat in between. The name Ground Beetle implies that they are an exclusively terrestrial group of organisms, but not all are, as some are arboreal climbers sheltering beneath bark, while others are saxicolous and rely on sheer rock faces and crevices for survival (Slipinski 2013). A small number are even semi-aquatic. In Australia there are currently around 3,100 described species, with Australia's carabid fauna being unique in that certain subfamilies which are poorly represented overseas are more common in Australia and vice versa (Lawrence 2019). An example of this is in the subfamily Carabinae which includes the two large genera, *Calosoma* and *Carabus* which have a broad overseas distribution, but in Australia are restricted to just one *Calosoma* species and the ancient genus *Pamborus* (Lawrence 2019). South-eastern Queensland has an amazingly rich carabid fauna, due to it being at a junction point of a range of habitats (CSIRO 2007). The northern rainforest areas of Cairns and Cape York Peninsula have a range of species of Papuan origin, as well as ancient Gondwanan species found in high montane regions (CSIRO 2007). Dry arid areas have a high number of carabid species, especially of the genus *Carenum* in central Australia. Cool climates such as Tasmania and Victoria also have their own unique carabid fauna, which is distinct from the rest of the continent, with many endemic species. In this paper I introduce the subfamilies of Australian Carabidae, indicate the total number of genera in each of these subfamilies, and discuss some of the more interesting and common members of each subfamily. Subfamilies are arranged in alphabetical rather than taxonomic order.

Brachininae: Bombardier Beetles

Brachininae is a small subfamily of approximately 500 species present on all continents except Antarctica with the highest diversity in central Asia and north America. In Australia only a single widely-distributed genus occurs, *Pheropsophus* (Fig. 1), with seven known species from the Australian mainland (Slipinski 2013).

Helluonidius cyanipennis (Harpalinae) (Mt. Crosby, Queensland)

Brachininae are fast nocturnal hunters with several species being common around bodies of water. Species of *Pheropsophus* range in size from 15 mm to 205 mm in length, and the adult beetles are often a dark blackish colour with a speckled pattern or with blotches, usually orange or yellow, perhaps advertising their unique chemical bioweapon (Lawrence 2019). Several Carabidae can spray a foul-smelling discharge from their abdomens, but Brachininae have attained a world-renowned status, possessing the ability to produce a small and powerful vapour which is the result of several chemical reactions which occur in two chambers at the end of the abdomen of the beetle (UK Beetles 2017).

Broscinae: Big-headed Ground Beetles

Broscinae is a small subfamily of around 290 species worldwide in 35 genera, with 10 genera in Australia. Broscinae are restricted to temperate regions across the world with the greatest number of species present in Gondwanan regions such as Chile, South Africa and Australia. All species are considered small to medium sized and are found in most regions in Australia with the greatest diversity in arid and semiarid regions, as well as in wet forests in Tasmania and Victoria (Lawrence 2019). Some members of the subfamily are often confused with the subfamily

Scaritinae but can be distinguished by the externally smooth anterior tibiae in Broscinae, compared with internally rough-edged tibiae in Scatrinanae (UK Beetles 2017). The pronotum in Broscinae is additionally bulging and widest in the middle portion compared to most members of Scaritinae in which the pronotum has a uniform shape. The most distinctive genus in Broscinae is *Apotomus* which visually does not look like any other members of the subfamily. *Apotomus* are small arboreal species and are capable of flight (UK Beetles 2017). *Promoceradus* is a large genus restricted to southern regions of Australia including the south-west region of Western Australia and includes some spectacular species such as *P. viridiaeneus* and *P. insignis* which are metallic green in coloration. *Percosoma* is a genus containing three species restricted to Southern Victoria and Tasmania which are terrestrial carnivores of moist temperate rainforest and eucalypt woodland (Tasmania Beetles, 2012). The genera *Adotela* (Fig. 2) and *Cerotalis* are medium-sized and black to purple in colour which have a broad distribution across Australia's arid interior (Lawrence 2019).

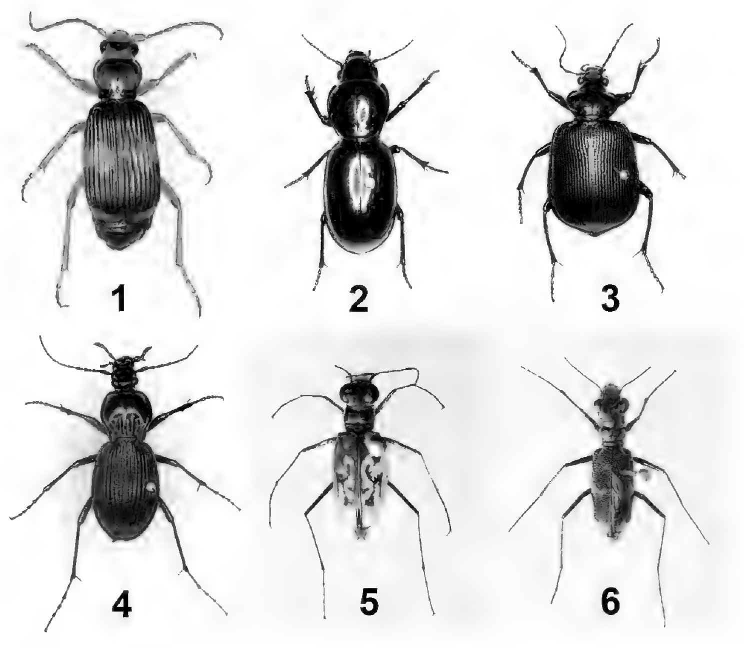
Carabinae: True Ground Beetles

Carabinae is the largest subfamily of Carabidae in the world. The largest concentration of species being in the genus *Carabus* with over 1000 described species worldwide (UK Beetles 2017). In Australia this group is limited to just two genera, with *Calosoma*, a cosmopolitan genus, just reaching the continent with a single widespread, bright metallic green species, *C. schayeri* (Lawrence 2019). It is one of the most commonly-observed beetles in arid regions of the continent. Like all *Calosoma*, *C. schayeri* (Fig. 3) is predominantly a caterpillar specialist feeding on larvae of Lepidoptera, in addition to carrion on occasions (Lawrence 2019). The endemic genus *Pamborus* is restricted to mainly rainforests in mountainous regions on Australia's eastern coast and are snail and worm hunters, living under debris and in leaf litter. *Pamborus* (Fig. 4) varies from being a widespread generalist species such as *P. alternans* which has a broad distribution in most moist mountainous habitats in southern Queensland and New South Wales, to quite restricted species most often found only in one area or on one mountain range, such as *P. cooloolensis* which is restricted to the rainforests of Cooloola National Park, and *P. opacous* which is restricted to the higher slopes of Mt Lewis, north of Cairns (CSIRO 2007).

Cicindelinae: Tiger Beetles

Cicindelinae, or Tiger Beetles are a group of chiefly diurnal predators that have the highest diversity in Asia, as well as in the Neotropics, with over 2000 descibed species worldwide (CSIRO 2007), with six genera recorded from Australia.

Australian species are usually brightly coloured with metallic greens, pinks, reds or blacks (Slipinski 2013). All have large protruding eyes, serrated mandibles, and relatively long legs (CSIRO 2007). Members of the genus *Cicindela* (Fig. 5) reportedly can run 9 km per hour or 125 body lengths per second, the equivalent of a human being running almost two football fields in one second (Lawrence 2019). *Cicindela* is the most common genus in Australia with several species often observed on open ground on edges of salt marshes, hot sandy tracks and sand dunes (CSIRO 2007). *Megacephela* includes the largest Australian Cicindelinae species, including many salt marsh specialists such as *M. australis* (CSIRO 2007). Two genera are arboreal specialists; *Dystipsidera* (Fig. 6) commonly observed on tree trunks and the unusual species, *Tricondyla aptera*, a flightless tiger beetle restricted to rainforests of Cape York Peninsula (Slipinski 2013). Larvae of this subfamily are ferocious predators that construct vertical burrows to efficiently catch prey (Lawrence 2019).



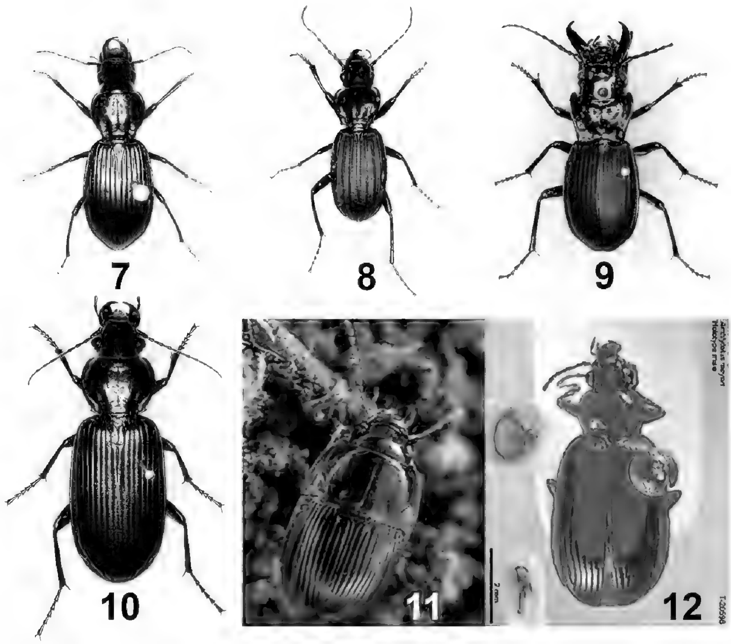
Figs 1–6. Some genera of the Australian Carabidae [habitus lengths mm in square parentheses]. **Fig. 1.** *Pheropsophus* [18], **Fig. 2.** *Adotela* [22], **Fig. 3.** *Calosoma* [25], **Fig. 4.** *Pamborus* [25], **Fig. 5.** *Cicindela* [12], **Fig. 6.** *Dystipsidera* [15].

Harpalinae: Harp Ground Beetles

Harpalinae is the largest subfamily of Carabidae in Australia. Worldwide, 6400 described species are known with over 130 genera occurring in Australia (Slipinski 2013). The genus *Notonomus* (Fig. 7) is one of the largest of the Carabidae genera in Australia (Lawrence 2019). Along Australia's eastern coast, over 100 species of *Notonomus* occur. Some species are brilliantly coloured with metallic pinks, greens, reds and blues, while others are drab in colour, and are often black (Lawrence 2019). Many species in this subfamily are forest dwellers and are stoutly built, including the large rainforest burrowers such as *Nurus*, *Castelnaudia* (Fig. 8) and *Trichosternus* (Lawrence 2019). These species are quite ancient beetles with heavy connections to Gondwanan rainforests with places like south-eastern Queensland having endemic species restricted to single mountain ranges such as *N. imperialis* (Fig. 9) which is endemic to the Tamborine Plateau. Included in this subfamily is Australia's largest Carabidae species, *Catadromus* (Fig. 10), which are predominantly black and dark green and are inhabitants of flood plains and waterways (Slipinski 2013). In this subfamily is the largest species on the continent, *Hyperion schroetteri*, which can attain a length of 125 mm in exceptionally large specimens and is a predator of larvae of Scarabidae in rotten trees (Slipinski 2013). *Mecynognathus damelii* is another monstrous beetle which can easily attain lengths of over 80 mm and is restricted to the iron rich, red soil of Lockerbie scrub near Bamaga at Cape York. *Chlaenius* includes some very common brightly-coloured species such as *C. flaviguttatus*, *C. australis* and *C. greyanus*. This genus is commonly encountered in farmland as well as in drier inland areas. The subfamily also includes arid adapted species, such as *Gigadema* species that can be found in flat sandy regions and dunes throughout central Australia. The adults use their long thin legs and dorsally-depressed body to hide in small crevices from the heat of the day (CSIRO 2007).

Migadopinae: Long Antennae Ground Beetles

Migadopinae is a small subfamily containing only a few hundred described species, with the highest diversity in Chile and New Zealand. Some species can even be found on subantarctic islands and are one of the most cold-tolerant beetles in the world (Slipinski 2013). Only five genera occur in Australia, and most species are squat-bodied and very small with little delineation from the elytra to the pronotum (CSIRO 2007). *Stichonotus* (Fig. 11) is the most often seen genus of Migadopinae and can be quite abundant in disturbed areas and are likely nocturnal or crepuscular (Tasmania Beetles 2012). Many genera remain poorly studied with little information available especially *Nebriosoma* which is a monotypic genus containing only *N. fallax* and is known from just a handful of specimens from Cooma, NSW (Slipinski 2013).



Figs 7–12. Some genera of the Australian Carabidae [habitus lengths mm in square parentheses]. **Fig. 7.** *Notonomus* [15], **Fig. 8.** *Castelnaudia* [27], **Fig. 9.** *Nurus imperialis* [35], **Fig. 10.** *Catadromus* [40], **Fig. 11.** *Stichonotus* [5], **Fig. 12.** *Amblytelus* [5].

Moriomorphinae and Psydrinae: Hunch-backed Ground Beetles

Moriomorphinae is a subfamily of mainly small hunch-backed ground beetles. Initially most genera within this subfamily were contained in Psydrinae until a recent study split the group with most Australian species now placed in Moriomorphinae with just a single genus remaining in Psydrinae. Thus, for simplicity both families will be described in this section (Slipinski 2013). Most members are small to moderately-sized beetles that are often found in trees or living in rotten logs. Psydrinae in Australia is now represented by just a single genus *Laccocenus* containing two species both restricted to south-eastern Queensland and north-eastern New South Wales (Slipinski 2013). Moriomorphinae contains the remaining genera including the notable genus *Mecyclothorax* which includes 400 species distributed mainly in the Pacific region from Hawaii to New Caledonia and occur even on high mountains of New Zealand. Based on genetic evidence, the large genus originated in Australia (Liebherr 2013). *Amblytelus* (Fig. 12) is an unusual genus in the group being a genus of flat arboreal species that are often brightly coloured and physically resemble Harpalinae (Liebherr 2013).

Paussinae: Ant Nest Beetles

Paussinae is small subfamily of unique small ground beetles with over 800 species world-wide, in 49 genera, with only three genera in Australia (Lawrence 2019). The most unique feature is their small squat elytra along with their very flattened unusually-shaped antennae which contain scent glands used to attract ants (Lawrence 2019). The beetles also possess a defensive spray but not as developed as that in the Brachininae. *Arthropterus* (Fig. 13) constitutes most of the Australian species and are cryptic, ant-nest inhabitants that are attracted infrequently to lights. *Mystropomus* (Fig. 14) is a unique genus and is unlike any other member of this subfamily in physical structure. They are ground dwelling inhabitants of rainforests of eastern Australia and possess long thin antennae, and were originally included in the Harpalinae before the genus was examined genetically. Larvae of Paussinae are myrmecophilous and live inside ant's nests, feeding on ant larvae and pupae (Lawrence 2019).

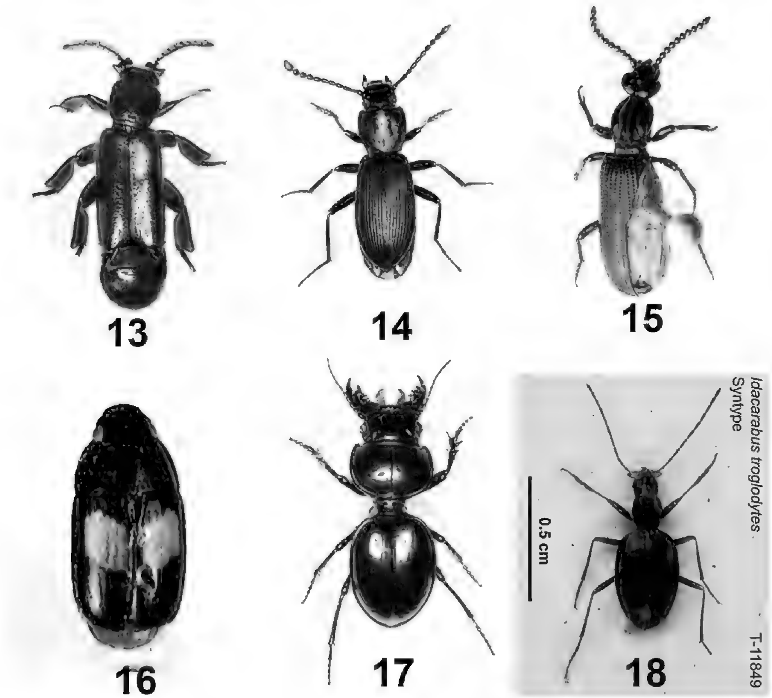
Rhysodinae: Wrinkled Bark Beetles

This subfamily of Carabidae was once considered to be a separate family but is now considered genetically to be part of the Carabidae. In addition, some structural features such as antennae and tarsi place them as a subfamily of Carabidae (Lawrence 2019). There are 350 species known worldwide in 20 genera, with most species being in the southern hemisphere, especially in south America and Papua New Guinea. Five genera are known from Australia, with two unique endemic genera *Leoglymmius* and *Sloanoglymmius* (Fig. 15) (Lawrence 2019). All are arboreal species associated with fungi and rotting wood and spend most of their lives in dark moist cavities.

Pseudomorphinae: Smooth-backed Beetles

Pseudomorphinae is a predominantly Australian subfamily of generally small, flattened oval-shaped beetles whose body shape conceals their antennae and limbs. At first glance they have a superficial resemblance to the Hydrophilidae which is a family of distantly-related water beetles (Slipinski 2013). A total of five genera are known from the Australian continent with the largest concentration of species being present in eucalypt woodlands on Australia's eastern coast. *Adelotopus* is a large genus featuring many large species which are predominately a dark black to brown and have small club-shaped antennae which are typical of the subfamily (Slipinski 2013). However, the genus *Sphallomorpha* (Fig. 16) contains smaller brightly-coloured species which have fairly long, thin segmented antennae which is unusual

for this subfamily (Lawrence 2019). Adult beetles are voracious predators of ants and construct burrows usually in trees or logs adjacent to nests or ant trails and are ambush hunters. Larvae are not too dissimilar to Paussinae and likewise live in ant's nests feeding on ant larvae (Lawrence 2019).



Figs 13–18. Some genera of the Australian Carabidae [habitus lengths mm in square parentheses]. **Fig. 13.** *Arthropterus* [12], **Fig. 14.** *Mystropomus* [10], **Fig. 15.** *Sloanoglymmius* [10], **Fig. 16.** *Sphallomorpha* [5], **Fig. 17.** *Carenum* [25], **Fig. 18.** *Idacarabus* [1].

Scaritinae: Pedunculate Ground Beetles

Scaritinae is a large and distinctive subfamily of Carabidae with almost 1,900 described species worldwide and occur on almost every continent, with the greatest diversity of species being present in the southern hemisphere especially Australia with over 200 species and 21 genera. Most species are small to very large with a general fossorial lifestyle being present either under logs, rocks, debris or free living in leaf litter or soil (CSIRO 2007). Most species burrow using their

heavily-modified front tibia which are greatly enlarged for digging (Lawrence 2019). Some small species such as the genus *Clivina* are capable of flight and are often attracted to UV lights. Of the ground dwelling flightless species, the genera *Carenum* (Fig. 17) *Neocarenum*, *Laccopetrum* and *Conopetrum* are of special note due to their diversity in arid regions as well as many species being brilliant metallic greens, blues and purples (Lawrence 2019). *Scaraphites* is a mainly southern Australia genus with particular strong holds in the mallee country of New South Wales, Victoria and South Australia (Lawrence, 2019). All species are carnivorous, but some are capable scavengers and come readily to rotting meat, especially large mammal roadkill.

Trechinae: Minute Soil Ground Beetles

Trechinae includes a variety of small often minute species that include a variety of fossorial inhabitants of damp litter and soil as well as fascinating troglobitic species which have large setae for their body size and are blind (Tas DPI 2021). Over 30 genera are known from Australia and likely many more are to be found due to their small size and overall cryptic habits (Slipinski 2013). Most species are found in southern high-altitude areas along the east coast with many species present in Tasmania (Slipinski 2013). *Perileptus* is a genus typical of the subfamily of which members are small dull-coloured species that inhabit gravel or sand beside streams and creeks. *Idacarabus* (Fig 18) is a fascinating blind inhabitant of caves and is a specialist hunter of the other troglobites that share its habitat (Tas DPI 2021).

Acknowledgments

I would like to acknowledge my grandparents Tina and Trevor Lambkin who have aided with reviewing and have been pushing me to publish something for years, the help is appreciated. I acknowledge the Atlas of Living Australia for several images of specimens I do not possess in my personal Carabid collection.

References

CSIRO. 2007. *CARABIDAE: Ground Beetles*. Retrieved from CSIRO Insects and their Allies: Available online URL https://www.ento.csiro.au/education/insects/coleoptera_families/carabidae.html [accessed 1 August 2022].

Lawrence, A. S. 2019. *Australian Beetles Archostemata, Myxophaga, Adephaga, Polyphaga (part) Volume 2*. Clayton, South VIC, 3169: CSIRO Publishing.

Liebherr, J. K. 2013. The Mecyclothorax beetles (Coleoptera, Carabidae, Moriomorphini) of Tahiti, Society Islands. *Zookeys* **322**: 1-170.

Slipinski, J. F. 2013. *Australian Beetles Morphology, Classification and Keys Volume 1*. Clayton South, VIC: CSIRO Publishing.

Tas DPI. 2021. *Threatened Species Listing Ida Bay Cave Beetle*. Retrieved from Natural Values Atlas Australia, available online URL: https://www.naturalvaluesatlas.tas.gov.au [accessed 1 August 2022].

Tasmania Beetles. 2012. *Ground Beetles Carabidae*. Retrieved from Tasmania Beetles: Available online URL https://sites.google.com/site/lynneforster/carabidae-groundbeetles [accessed 1 August 2022].

UK Beetles. 2017. *Broscinae, UK Beetles*. Retrieved from UK Beetles: *Available online URL* https://www.ukbeetles.co.uk/broscinae [accessed 1 August 2022].

The Bulloak Mistletoe (*Amyema linophylla*)

Ross Kendall

I wish to correct an error that I made in the preparation the Club's publication "The Mistletoes of Subtropical Queensland, New South Wales and Victoria" released in April 2016.

On page 35 of the book is an erroneous image of the mistletoe fruit due to the fact that I misidentified the fruit of an adjacent mistletoe – a Lysiana.

After frequent field searching, I was, earlier this year, able to confirm the justifiable doubts of my co-author John Moss by finally finding and photographing the correct fruit, an image of which appears below.

Report on the presentation by Geoff Thompson to our members at the Annual General Meeting held on 9 April at Karawatha Discovery Centre: Imaging and Insects – a life spent collecting, drawing and photographing invertebrates

Jon Hartas

Our club President, Trevor, describes Geoff as a Museum legend, the go-to man for photographic and artistic enquiries.

Geoff took us on a fascinating journey into the world of insect imaging. Beginning in 1975 he learned scientific illustration "on the job", working as a research assistant at the Entomology Department, University of Queensland. In 1982, Geoff started work at the Queensland Museum helping then curator Geoff Monteith to look after and enlarge the insect collection. He continued to illustrate insects; particularly new species discovered from Monteith's rainforest surveys (Fig. 1).

Fig.1. Geoff Thompson

Geoff regaled us with stories of intrepid field trips into the Daintree in 1987. An expedition put a track up to Mt Sorrow through thorny wait-a-while palm and difficult terrain. Another included a five-day walk up Manjal Jimalji

(Devils Thumb) (Fig. 2). Much of the interest of the expedition centred around the unique fauna of high-mountain insects, such as Peloridiidae Moss bugs, arboreal carab beetles, leafhoppers, stag beetles and Tenebrionidae darkling beetles, but also plant species such as the Resurrection plant and the Daintree Pine.

Fig. 2. Manjal Jimalji

Geoff outlined his progression through drawing to traditional scraperboard technique (Fig. 3). This begins with a stereo microscope with a camera lucida attachment. Tracing and special in-fill methods taking three weeks produces a beautiful and anatomically accurate image.

He has been commissioned to do watercolours and also pursued a private interest in printmaking.

In 2005 Geoff won a Queensland-Smithsonian Fellowship, spent time at the National Museum of Natural History, Washington DC, learning to illustrate digitally - a pencil outline is scanned, traced and filled. Each image was, again, three weeks work.

Geoff now takes focus-stacked photographs using highly specialized hardware and uses digital illustration techniques to improve them. The level of detail achieved has to be seen to be believed, normally only seen with a Scanning Electron Microscope (Fig. 4).

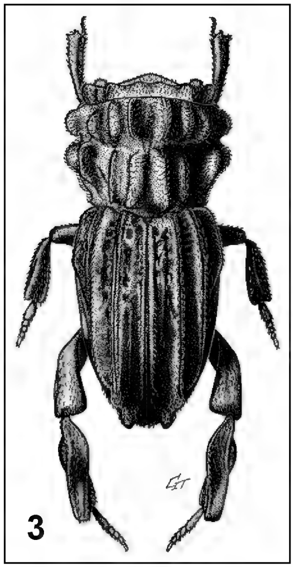


Fig. 3. Scraperboard image of *Monteitheolus fijiensis*

Fig. 4. Focus-stacked image of fly head

Geoff's journey from straight black and white drawings to a photographic riot of colour and detail was a fascinating and inspirational story, a cross-over between science and art, detail and beauty.

Geoff still works for the Queensland Museum. He continues drawing and takes pictures in the back yard for himself.

Acknowledgements

I would like to thank the Queensland Museum for the use of their images. The links below provide further information if you are interested.

https://cobbandco.qm.qld.gov.au/Find+out+about/Behind+the+Scenes/Scientific+illustrations/Insect+illustrators/~/media/66865D088AEE424C8D4251EF54EF89C2.ashx?h=199&w=300&as=1

https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Ftse1.mm.bing.net%2Fth%3Fid%3DOIP.xyXXFd7yxE0umtm_d22wtwHaE7%26pid%3DApi&f=1

Australian Scale Insects – Report on the presentation by Dr Penny Mills to our members at our meeting held on 7th May

Bernie Franzmann

My knowledge of scale insects was largely confined to the pest species, which can be the bane of fruit growers. I now know something of the other scale insects which, I am aware now, are very fascinating in both structure and biology.

Penny began by describing how she became involved with scale insects via her involvement with studies of the Lobate Lac Scale, *Paratachardina pseudolobata*. It is a highly polyphagous pest associated with over 300 host species.

She introduced us to the amazing world of gall-inducing scale insects, *Apiomorpha*. These insects induce sexually-dimorphic galls on *Eucalyptus*, which include a large variety of galls induced by females of different size and structure. Some of the galls can be up to 30 cm long and are some of the largest insect-induced galls known.

They are difficult to identify morphologically as they are generally jelly-like insects with little structure to examine. However, the taxonomy is greatly assisted by the study of their genetics. They have chromosome numbers from 2n=4–192, which makes *Apiomorpha* one of the most chromosomally diverse genus in the whole animal kingdom.

Penny has worked on several species-groups, including *A. ovicola* (Fig. 1) and found, by examining chromosome variation, DNA sequences, and host-use specificity, that there are multiple species currently under the name of *A. ovicola*.

The other main species-group Penny has focussed on is the *A. hilli* species group found in northern and western Australia. Previously there was only a single species in the group, but using genetics, morphology and host-use preferences, the group now includes four species. Two of these species (*A. gongylocarpae* and *A. jucundacrispi*; Fig. 2) were new to science, and all four species induce galls on either one to several species of eucalypts found within *E.* subgenus *Eudesmia*.

Fig 1. Galls induced by female *Apiomorpha ovicola* on *Eucalyptus haemastoma* (Sydney scribbly gum)

She is also currently involved in a project investigating the biological control of Giant Pine Scale, *Marchalina hellenica* (Fig. 3). The scale, which is a pest of pine, fir and spruce trees was first detected in Australia in 2014.

The project aims to find a suitable predator of the scale to introduce into Australia. Before importation is allowed, it has to be determined whether the predator will not attack our native scales. Penny and her Agriculture Victoria colleagues Greg Lefoe, Umar Lubanga and Nicholas Collison have developed a list of native scales that the predator could possibly attack. The native scales will be screened in Quarantine with the predator, and the predator won't be released if there is any chance of it damaging native scale populations.

Fig. 2. Penny holding galls of two recently described species *Apiomorpha jucunda-crispi* and *A. gongylocarpae*

Fig. 3. Infestation of *Marchalina hellenica*, Giant Pine Scale, in a pine forest in Crete, Greece

I had always thought that scales were a bit different and strange, but she told us about one of them (*Callipappus* sp.) which may be the strangest of them all. She has called this one "the marsupial scale". The immatures feed underground on the roots of trees. When mature they emerge from the ground. The males (which are called Bird-of-Paradise Flies) fly to the females and mate and soon die. The females then invaginate their rear end and lay their eggs into this pouch. As the female slowly dies, the eggs are incubated in this pouch (which led Penny to see this as a marsupium).

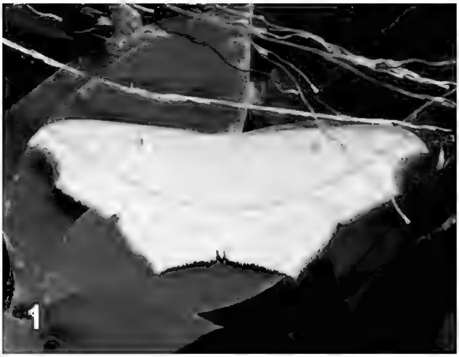
So, in summary, a fascinating, informative and interesting presentation.

Butterfly & Other Invertebrates Club Inc. (BOIC), Butterfly & Other Invertebrates Survey, Cabbage Tree Creek, Taigum, Qld. Saturday 26 March 2022

Dawn Franzmann

Brisbane had received unprecedented rain and wind leading up to this Saturday. Many suburbs, creeks and roadways were flooded and a high level of damage occurred. Cabbage Tree Creek didn't escape and there was a tremendous amount of debris and evidence of the loss of habitat, nectar and host plants on both sides of the creek.

It had been doubtful as to whether we would be able to conduct the survey, however, that morning we awoke to clear skies. Nineteen BOIC members attended. We commenced our walk at 9.30am. There wasn't an abundance of butterflies in flight, however, towards the end of the walk, we did manage to observe and identify a few butterflies and a selection of other invertebrates.

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LIST OF CAPTIONS:

Fig. 1. Geometrid moth, Cabbage Tree Creek © Russel Denton
Fig. 2. Tiger Moth, Cabbage Tree Creek © Russel Denton
Fig. 3. White Acacia Leaf beetle, Cabbage Tree Creek © Russel Denton
Fig. 4. Purple Crow on Trevor Lambkin's hand, Cabbage Tree Creek © Russel Denton
Fig. 5. Jezebel Nymph, Cabbage Tree Creek © Russel Denton
Fig. 6. Metallic Green Acacia Beetle, Cabbage Tree Creek © Russel Denton
Fig. 7. Small Green Banded Blue, Cabbage Tree Creek © Deanne Gaskill
Fig. 8. Trevor Lambkin on the banks of Cabbage Tree Creek © Deanne Gaskill

Those observed and recorded are listed in the following tables.

BUTTERFLY & OTHER INVERTEBRATES CLUB Inc.
2021/2022 SUMMER BUTTERFLY & OTHER INVERTEBRATES SURVEY No. 3
CABBAGE TREE CREEK, TAIGUM
SATURDAY 26 MARCH 2022

(Butterfly data will be included in the Brisbane's Big Butterfly Count.)

COMMON NAME Butterfly	**SCIENTIFIC NAME**	**CABBAGE TREE CREEK TAIGUM**
Narrow-brand Grass Dart	*Ocybadistes flavovittatus*	Collected, identified and released between the hours of 9.30am – 11.30am Leading up to this day Brisbane and SE Qld. had experienced severe flooding. The vegetation and habitats on either side of the creek had been demolished by flood waters. Slightly overcast, temp. 26°.
Blue Triangle	*Graphium sarpedon*	
Fuscous Swallowtail	*Papilio fuscus*	
Orchard Swallowtail	*Papilio aegeus*	
Small Grass Yellow	*Eurema brigitta*	
Evening Brown	*Melanitis leda*	
Brown Ringlet	*Hypocysta metirius*	
Purple Crow	*Euploea tulliolus*	
Common Eggfly	*Hypolimnas bolina*	
Jezebel Nymph	*Mynes geoffroyi*	
Tailed Emperor	*Polyura sempronius*	
Grass Blue	*Zizina labradus*	
Small Green Banded Blue	*Psychonotis caelius*	
Purple Moonbeam	*Philiris innotata*	

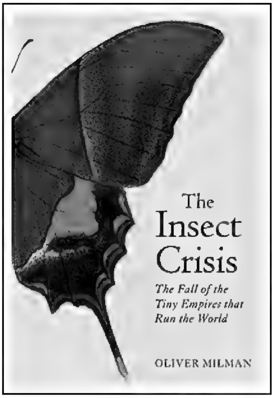
Trevor Lambkin, Dawn Franzmann and Russel Denton
Recorders
26/03/2022

BUTTERFLY & OTHER INVERTEBRATES CLUB Inc. 2021/2022 SUMMER BUTTERFLY & OTHER INVERTEBRATES SURVEY No. 3 CABBAGE TREE CREEK, TAIGUM SATURDAY 26 MARCH 2022		
COMMON NAME Other Invertebrates	**SCIENTIFIC NAME**	**CABBAGE TREE CREEK TAIGUM**
Damsel Fly	ODONOTA: SO. Zygoptera	Collected, identified and released between the hours of 9.30am – 11.30am Leading up to this day Brisbane and SE Qld. had experienced severe flooding. The vegetation and habitats on either side of the creek had been demolished by flood waters. Slightly overcast, temp. 26°.
Bluetailed Damsel Fly	ODONATA: *Ischnura heterosticta*	
Grass Webworm	LEPIDOPTERA: *Zerpetogramma licarsisalis*	
Hawk Moth	LEPIDOPTERA: F. Sphingidae	
Geometrid moth	LEPIDOPTERA: F. Geometridae	
Tiger Moth	LEPIDOPTERA: *Azura lydia*	
Tiger Crane Fly	DIPTERA: *Nephrotoma australasiae*	
Thick-headed Fly	DIPTERA: F. Conopidae	
Hedge Grasshopper	ORTHOPTERA: *Valanga irregularis*	
Melaluca Saw Fly	HYMENOPTERA: *Lophyrotoma zonalis*	
Rice Paddy Bug	HEMIPTERA: *Leptocorisa acuta*	
White Acacia Leaf Beetle	COLEOPTERA: *Dicranosterna circe*	
Metallic Green Acacia Beetle	COLEOPTERA: *Calomela ruficeps*	
Net Winged Beetle	COLEOPTERA: F. Lycidae	
Variable Ladybird	COLEOPTERA: *Coelophora inequalis*	
Wolf Spider	ARACHNIDA: F. Lycosidae	

Trevor Lambkin, Dawn Franzmann and Russel Denton
Recorders
26/03/2022

The Insect Crisis: The Fall of the Tiny Empires that Run the World by Oliver Milman, 2022

Atlantic Books London. Distributed by United Books Distributors, Scoresby, VIC: 260 pp. RRP AUD$29.99.



Reviewed by Trevor A. Lambkin

The Insect Crisis by Oliver Milman comes at a pertinent time for the future of invertebrates on earth. With the degree of land clearing and insecticide use not abating, this book provides firmly grounded evidence that the author has painstakingly gathered to provide a current assessment of the worldwide plight of invertebrates.

The book starts with a *Prologue* which sets the scene for the remainder of the book. In the first couple of chapters, he spells out the absolute dependency that the world has on its invertebrates. Insects are the primary food source of the world's 10,000 bird species for example, all the world's animal corpses are efficiently processed by insects, insect pollinators provide the world its cash crops and regenerate its forests by fertilizing billions of flowers every hour (even the humble cocoa flower which provides the world with its chocolate), 8,000 species of dung beetle process all the world's dung daily, and termites and beetle larvae break down, together with fungi and bacteria, all the world's fallen timber.

From then the book is divided into nine chapters addressing different aspects of dwindling invertebrate numbers through many regions of the world. The evidence the author provides tells the story of declines in invertebrate numbers, especially insects, linked to anthropogenic disturbances to our planet. The author starts with, for example, graphic data regarding a 75% decline in flying insect biomass recorded in 2017 in Germany following a 27-year surveillance period, and this was in protected forest areas. He goes on to say that not only land clearing is devastating insect numbers but the creation of large swathes of monocultures such as crops, and turfed areas are having an irrevocable effect on biodiversity and natural pest suppression.

In short, Milman spells out the drivers that are contributing to loss of invertebrate diversity. Simply put, they are the loss of habitat through deforestation, uncontrolled and excessive use of insecticides, the replacement of complex forest habitats with sterile monocultures and the effects of climate change on the world's invertebrates.

In my view, Chapter 4, entitled *The Peak of the Insecticide*, tells the most alarming story. Having worked in agricultural and animal industry research myself, this chapter brought to my mind the dependency to insecticides that chemical manufacturers promote at all levels of primary production. The imbalance and decline in insect numbers is nothing new as the author explains that as early as 1936, there were concerns regarding the deleterious effects of insecticides on insect populations. The effects of universal applications of systemic neonicotinoids such as the chemical imidacloprid are alarming and the author spells this out in a frank manner, undoubtedly to the disapproval of the major chemical producers. The key concern of imidacloprid is the systemic transfer of the chemical into flowers, which the chemical is then cross transmitted into the visiting bee, who then takes the chemical back to the hive. In addition, in the USA, there was little evidence to suggest that the application of neonicotinoids on soy-bean crops improved the harvest, while in France a study of 1,000 farms found that 94% of the farms lost no production by reducing pesticide use. What the author did highlight was that application of insecticides tend to remove natural enemies and so exacerbate the pest problem.

An intriguing chapter is *The Labor of Honeybees* (Chapter 6) in which the author describes the role of apiarists in maintaining the supply of cash crops, through a rotation and movement of honeybee hives for pollination of crops, specifically in the United States, England and in Australia. This was a very enlightening chapter and describes a process that is poorly known by the average person. In the three countries, thousands of hives are transported by truck across the three nations to cropping areas to service the pollination requirements for specific crops. The almond industry in California, little to my knowledge, relies totally on these 'immigrant bees' being transported into orchards to service the pollination needs of the industry. One might ask, why the need for this, but the author reminds the reader that because of the degree of land clearing and reduced plant diversity, the numbers of naturally occurring native bees is now only a fraction of what there used to be. In addition, honeybees have taken a significant hit from the overuse of neonicotinoid insecticides, a situation exacerbated by the unchecked spread of parasitic *Varroa* mites throughout most countries, these mites spreading the lethal honeybee infection, *Nosema*. Thankfully Australia, with its effective quarantine surveillance, is still free of this parasite in our beehives.

Chapter 7 spells out the declining regularity of the two major monarch migrations and their winter roosting in Mexico and California. Again, the author provides strong verified evidence that indicates that the two major migration events

of *Danaus plexippus* are being disrupted and impacted by deforestation, pesticide use and climate change. What is interesting to read is that the roosting of the millions of individuals in Mexico is reliant on a specific tree (oyamel) that offers the correct shelter and conditions such that the roosting population can be at the correct temperature over the winter to ensure survival of the butterflies. These trees, which are restricted to a specific mountain at a specific elevation, are struggling to survive due to what is believed to be rising temperatures because of climate change drivers. Reduced numbers of monarchs are being observed at the two roosting areas in Mexico and California, in addition to climate effects on milkweed plants across the USA, particularly in Texas where rising temperatures are reducing survival of the native milkweed species that the monarchs rely on, enroute. It appears that the roosting monarchs are in peril.

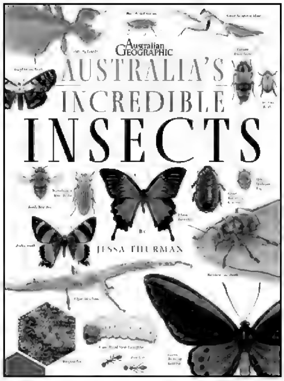
Despite the author having appeared to research the subject very well (he has 18 pages of scientific references, 220 in all, commencing at p 223) the text in the initial chapters meanders around somewhat and is not at all succinct. For example, in the chapters prior to Chapter 4 (The Peak of the Insecticide) the author rambles from one subject to the next in a somewhat directionless manner which makes it difficult to follow. The author picks it up in Chapters 4 to 7, these chapters being much more succinct and focused on the chapter. Unfortunately, he slips back into this incoherent rambling part way through Chapter 7 (particularly the section on the Australian Butterfly Sanctuary, Kuranda commencing on p 179). Fortunately, the coherent well-formed chapters keep the reader's attention and make up for the shortfalls in the earlier chapters.

Finally, the author does give a glimmer of hope in saving our invertebrate fauna as in the last two chapters gives strong evidence of a tide of change in several countries to bring back these tiny empires that truly rule the world, and thus keep the world habitable. Overall, a good read, despite the meandering text in some parts, and I think well worth the $30 price tag. Reiterating, Chapters 4 and 6 are wonderful in that they explain a realm that few of us know, i.e., the world of insecticide overuse and exploitation, and the contribution that bees make to the whole world. Moreover, an important outcome of this book is that it raises the reader's awareness of the importance of our invertebrates, especially insects, and addresses the significant threat to insects and our own humanity through land clearing, the indiscriminate use of insecticides and the effects of climate change.

Australia's Incredible Insects by Jessa Thurman

Published by Australian Geographic, 2022

Reviewed by Dawn Franzmann



One word describes this 110-page book "Incredible".

This much anticipated book had finally reached our home and found its place on our book shelf, amongst the great writers of entomology. It stands high, literally in content and size, as it is 30 cm × 22 cm and contains 110 pages.

The author had first told me about her book last October and it has certainly been worth the wait. It is aimed at the 7–13 age group. However, it is just as applicable to an adult audience.

At first glance you are attracted to its, glossy hard cover, with nineteen insect images in full colour and attached names. The back cover is not lacking either. Every space has been utilised and with a side bar photo of our beautiful Blue Banded Bees. Opening the book leads the reader into a magical wonderland of 250 images of Australian insects, a couple very rare and hard to find. Those that come to mind are the Honey Pot Ants. You don't come across them very often as you have to venture into the desert and dig them up. This would not deter the author in her quest to find the unusual for inclusion in her book.

The Introduction explains what is an insect, their structure and the complete life cycle in detail, by using creative layout of images to tell the story. The following pages explain the orders. In each order the author selects some of the families and tells little interesting stories about some of the species.

The general layout of the book is presented in a modern way with the use of graphics. This style is fast becoming popular especially with the younger reader. Every page offers colour, information and beautiful images. Distribution maps help the reader to know immediately, the location where they may find the particular insect. Insect facts are listed in hexagonal boxes that are continued throughout the book.

The lack of an alphabetical index is not an issue as the Contents page is detailed and explains exactly what each of the 10 chapters are about. Commencing with Beetles, following through with chapters on Bees and Wasps, Ants and Sawflies, Flies, Butterflies and Moths, True Bugs, Dragonflies Damselflies and Lacewings, Grasshoppers Katydids and Crickets, Mantids Roaches and Termites and finally Stick Insects.

The text is “pitched” just right for her intended audience. The majority of the images have been taken by the author herself and a few have been accredited to other photographers.

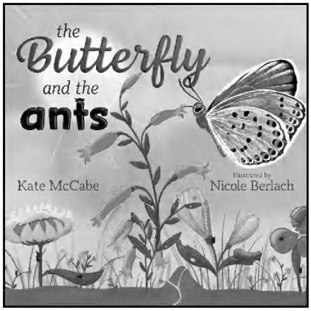
I found it hard to find any section where there was the slightest mistake. Any young person with a budding interest in insects should find it most instructive and interesting. I really have to say I have never seen a book like this before, aimed at the younger audience.

“Australia’s Incredible Insects” will make a perfect gift for all ages and you may find you will have to purchase another copy for your own collection. It is available in all good book stores, the BOIC Online Shop: www.boic.org.au and from the author herself jessathurman.com.au.

The Butterfly and the Ants by Kate McCabe with illustrations by Nicole Berlach

CSIRO Publication

Reviewed by Judy Ferrier



CSIRO's recent publication of the Young Reader's book, **"The Butterfly and the Ants"** (2022) by Kate McCabe with illustrations by Nicole Berlach is highly recommended. The author, inspired by her local "Eltham Copper Butterfly", narrates the life cycle of a particular species of the butterfly family Lycaenidae (*Plebejus argus*), the male of which is a spectacular iridescent blue in colour.

The book has broad appeal to warrant its inclusion in a child's list of nature books. It is full of biological information that is presented in such a way that it is likely to be absorbed effortlessly, as the child moves readily from page to page as the story line unfolds in a suspenseful roll of questions as to what happens next in a true "thriller" pattern.

The author also captures the young reader's attention by setting an intimate mood through addressing them directly and personalising this natural event. Her opening page asks the reader: "Who do you think this is?" The next quandary is set as: "Who will hatch out of it?" The child eagerly turns each page to check their answers.

After setting the scene, the processes of symbiosis, metamorphosis and ecdysis are described in language that is appropriately definitive (with helpful aids to pronunciation included). However, the tone of the book is kept light for primary aged readers via the insertion of childish vocabulary such as: "Goo", "Gross" and "Yucko".

The topic of the book, the symbiosis between some butterfly larvae and ants, explains clearly the benefit of mutual co-operation. The idea of interdependence is an important concept for children to grasp and is wonderfully illustrated by this species of the Lycaenid butterfly. The tireless work of the ants to protect the butterfly in its larval stage is rewarded by the provision of "Honeydew" by the caterpillar, which serves as a food source for them. This shows that, even in the insect world, sophisticated mutually beneficial relationships can develop between the most unlikely players!

Ms McCabe, well supported by Ms Berlach's illustrations, has done an excellent job in revealing one of the wonders of the natural world to her young readers by her choice of subject, use of appropriate language and her suspenseful unfolding of the events that lead to the emergence of the blue butterfly in all its glory.

COVER IMAGE

Freshly emerged female Indigo Flash (*Rapala veruna simsoni*)
Beaudesert, South East Queensland, 8.54 am 19/05/2022

In recent years, this northern species, previously known from as far south as Brisbane, has extended its range just into northern New South Wales. Future surveys may well increase its range even further south, particularly in coastal areas. Females of this species seem oblivious to humans and can be easy to approach for a close-up photograph (Wesley Jenkinson).

GUIDELINES FOR AUTHORS

Text to be 11 font size Times New Roman with 1.5 times New Roman spacing. Images are to be a minimum of 300dpi, originals separate to the document and captions provided for each image. Adherance to the deadlines for submission would be greatly appreciated.

All articles/contributions to be submitted to the Editorial Committee at secretaryboic@gmail.com.

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